U.S. Department of Transportation
National Highway Traffic Safety Administration

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Memorandum

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Subject: **ACTION**: Final Regulatory Evaluation

Date: JUN 12 2003

From: Rose A. McMurray
Rose A. McMurray
Associate Administrator
for Planning, Evaluation and Budget

Reply to Attn. of:

To: DOCKET

THRU: Nancy Bell for
Jacqueline Glassman
Chief Counsel

Please submit the attached "Final Regulatory Evaluation, FMVSS No. 139 New Pneumatic Tires for Light Vehicles, " June 2003 to the appropriate docket.

Attachment

cc:
Senior AA/Vehicle Safety
Senior AA/Policy & Operations
AA/Rulemaking
AA/Applied Research
AA/Advanced Research and Analysis
Chief Counsel

U.S. Department
Of Transportation
National Highway Traffic Safety Administration

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FINAL REGULATORY
EVALUATION

FMVSS NO. 139

NEW PNEUMATIC TIRES FOR LIGHT VEHICLES

Office of Regulatory Analysis and Evaluation
Plans and Policy
June 2003

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EXECUTIVE SUMMARY

This Final Regulatory Evaluation (FRE) provides an assessment of the costs, benefits, and other impacts of the final rule for Federal Motor Vehicle Safety Standard (FMVSS) No. 139, which upgrades the standards for new pneumatic tires for light vehicles.

Requirements

The agency proposed six tests: an upgrade in the high speed and endurance tests, new test procedures for the bead unseating test and road hazard impact test, and new tests for aging and low tire pressure. The final rule upgrades the requirements for the high speed and endurance test, and establishes a new low-pressure endurance test. Rulemaking was deferred on the bead-unseating test, road hazard test, and aging tests until further research can be completed.

The Rubber Manufacturers Association (RMA) commented that the NHTSA proposed tests were too rigorous and RMA proposed less stringent requirements. The agency has decided to adopt an upgraded high-speed test and endurance test similar to the RMA's proposal, except the agency did not reduce the LT tire test speed an additional 10km/hr.

Of the two low-pressure tests proposed in the NPRM, the agency has decided to adopt a slightly less stringent than proposed low-pressure endurance test similar to the RMA's proposal, except the agency did not reduce the LT tire test speed an additional 10km/hr.

The following table shows NHTSA's estimates of the average percent of light vehicle tires (P-metric and LT-tires) that would not pass the upgraded tire performance tests required in the final rule.

Percentage of Tires Not Passing the Final Rule's Performance Tests

Tire Type	High Speed Test	Endurance Test	Low Pressure Endurance Test	Combined Tests
P-metric	3 - 2%	2 - 3.5%	0 - 6%	5 - 11%
LT	4 - 7%	0 - 3%	0 - 8%	4 - 17%

The overall failure rate is dominated by P-metric tires because they represent 95% of all tires sold.

The agency is also requiring an increase in tire reserve load by changing the rule from 88% of the maximum load rating at maximum inflation pressure to 89% of vehicle placard inflation pressure.

Benefits

There are an estimated 78,000 crashes annually, of which over 23,000 are tow-away crashes, that are caused by blowouts or flat tires. There are an estimated 414 fatalities and 10,275 injuries in these crashes. The benefit of this final rule is to increase the strength, endurance, and heat resistance of tires.

It appears from the limited testing the agency has performed on tires, that about 5-11% of all present-day tires would fail the required upgrade performance tests. The agency estimates that the benefits from the upgraded high speed test, endurance test, and low-pressure endurance test are 1-4 lives saved, 23-102 injuries reduced, and 163 to 717 property damage only crashes avoided annually when all tires on the road meet the final rule requirements.

The agency cannot at this time quantify the benefit of changing the vehicle's available tire reserve load. For most vehicles this change will result in a small increase in the vehicle's available tire reserve load. The agency has a study underway to determine whether there are benefits of increasing the vehicle's available tire reserve load and to help estimate those benefits.

Anticipated Costs

The agency estimates an increase of $0.25-$1.00 per tire for those tires that fail the final rule requirements for high speed, endurance tests, and low-pressure endurance tests. There are an estimated 287 million light vehicle tires sold per year. We estimate that 5-11 percent of these tires would have to be redesigned or modified. The total annual cost is estimated to be $3.6 – $31.6 million.

Cost per Equivalent Life Saved

Based on the mid-points of the above estimates and a seven percent discount rate, the most likely present value cost per equivalent life saved for the tire performance upgrade tests is estimated to be about $5 million.

Lead Time

The agency has decided on a 4-year effective date that would coincide with the effective date requirements of the TPMS, which becomes mandatory for all vehicles in 2006.

I. INTRODUCTION AND BACKGROUND

A. Bridgestone/Firestone Recall

In 1990, Bridgestone/Firestone (BF) began production of a specially-designed, 15-inch ATX tire to be used as original equipment on the Ford Explorer that was being introduced in the 1991 model year. This tire was used as original equipment on several other Ford models and was sold directly to consumers as a replacement tire. A redesigned version of the tire was introduced in both 1995 and 1996 when the tire was renamed with two names, the ATX II and the Wilderness AT.

In 1996, BF started to receive a large number of claims relating to the 15-inch version of these tires. Most claims involved allegations of tread separations in which the tread and one of the steel belts separated from the other steel belt and carcass. Then in mid-1997, Ford dealers in the Middle East began to report similar problems with the 16-inch Wilderness AT tires. Testing conducted by Ford and BF led to limited recall actions in the Middle East, Venezuela, Malaysia, and Thailand in late 1999. In March 2000, the National Highway Traffic Safety Administration (NHTSA) opened an initial inquiry after 25 complaints were received between 1999 and 2000.

In May 2000, NHTSA opened a defect investigation into approximately 47 million ATX, ATX II, and Wilderness AT tires manufactured by BF, and issued a letter to Ford and BF requesting information about the high incident of tire failure on Ford Explorers. During July, Ford obtained and analyzed the tire failure data. The data revealed that the 15 inch ATX, ATX II and Wilderness AT tires had a very high failure rate, where the tread peels off.

After analysis, BF announced that a certain group of their tires, primarily on Ford Explorers, may have been more likely to experience tread separations. This increase in tread separations in extreme cases was caused by several factors acting in combination. These factors were the tread design of the P235/75R15 tires, certain manufacturing factors related to the Decatur, Illinois manufacturing plant, and external factors on Explorers, including low tire inflation pressure and overloading of the vehicle.

Ford had recommended a tire inflation pressure for their SUVs of 26 psi, which was less than the 30 psi inflation pressure recommended by BF. Both of these recommended inflation pressures are less than the "maximum inflation pressure" marked on the sidewall of the tire. Most vehicle manufacturers recommend tire inflation pressures that are less than the maximum pressure marked on the tire sidewall. Many manufacturers recommend pressures less than the tire manufacturer's recommended pressure. These slightly lower tire pressures can create greater traction which improves the vehicle's handling and stability. However, the greater traction is due to the increased friction between the tire and the road, which generates more heat in the tire, that can contribute to the failure of marginal performing tires. After the recall on September 24, 2000, Ford announced that it was informing its SUV owners to inflate their Firestone tires to 30 psi, which is the BF recommended pressure.

The Congressional inquiry eventually led to the Transportation Recall Enhancement, Accountability and Documentation **(TREAD)** Act of November 2000, that provided stronger penalties, longer recall periods, enhanced enforcement authority and increased funding to enable the agency to move vigorously with its defects investigations, to protect the public from the danger of defective products. The Act also specifically directed the agency to upgrade the tire safety standards, improve tire labeling information, and mandated that low tire pressure warning systems become required equipment on vehicles within two years. The tire Upgrade Standard requirements are not meant to address the specific problems associated with the tires covered by the recalls.

B. TREAD Act requirements for upgrading tire standards

The TREAD Act, Section. 10, Endurance and resistance standards for tires states, "The Secretary of Transportation shall conduct rulemaking to revise and update the tire standards published at 49 CFR 571.109 and 49 CFR 571 119. The Secretary shall complete the rulemaking under this section no later than June 1, 2002."

C. Current Tire Standards - FMVSS No. 109/110/117/119/120/129

The present tire standards: FMVSS No. 109; New pneumatic tires, FMVSS No. 110; Tire selection and rims; FMVSS No. 119; New pneumatic tires for vehicles other than passenger cars; and FMVSS No. 120; Tire selection and rims for vehicles other than passenger cars, were established over thirty years ago before radial tires were introduced into the market, and have remained virtually unchanged.

FMVSS No. 109, *New Pneumatic Tires B Passenger Cars*, 49 CFR 571.109, specifies the requirements for all tires manufactured for use on passenger cars manufactured after 1948. This standard, which was issued in 1967 under the National Traffic and Motor Vehicle Safety Act (Safety Act), specifies dimensions for tires used on passenger cars and requires that the tires meet specified strength, resistance to bead unseating, endurance, and high speed requirements, and be labeled with certain safety information. FMVSS No. 109 applies to passenger car (P-metric) tires produced for use on passenger cars, light trucks, and multipurpose passenger vehicles (MPVs), including sport utility vehicles (SUVs). The standard was adopted in January 1968 from the Society of Automotive Engineers (SAE) recommended practice J918c, *Passenger Car Tire Performance Requirements and Test Procedures*, which was first issued by the SAE in June 1965.

The current FMVSS No. 109 includes four performance requirements for tires: a **strength test** that evaluates resistance to puncture in the tread area, a resistance to **bead unseating test** that evaluates how well the tire bead is seated on the rim, an **endurance test** that evaluates resistance to heat buildup when the tire is run at 85%, 90%, and 100% of its rated load nonstop for a total of 34 hours in an under-inflated condition, and a **high speed test** that evaluates resistance to heat buildup when the tire is run at 88% of its maximum load at speeds of 75 miles per hour (mph), 80 mph, and 85 mph for 30 minutes at each speed. The FMVSS No. 109 performance requirements are discussed further in Chapter II.

For the purposes of testing tires to determine their compliance with these standards, several variable factors such as the tire=s inflation pressure, the load on the tire, and the rim on the tire on which a tire is mounted, must be specified. The agency specifies a limited number of permissible inflation pressures (or wheel sizes, in the case of the bead unseating test) to facilitate testing. The standard requires that each passenger car must have a maximum permissible inflation pressure labeled on its sidewall (S4.3). Section 4.2.1(b) lists the permissible maximum pressures: 32, 36, 40, or 60 pounds per square inch (psi) or 240, 280, 290, 300, 330, 340, 350, or 390 kiloPascals (kPa). A manufacturer's selection of a maximum pressure has the effect of determining the pressures at which its tire is tested. For each permissible maximum pressure, Table II of the standard specifies pressures at which the standard=s tests must be conducted. The intent of this provision is to limit the number of possible maximum inflation pressures and thereby reduce the likelihood of having tires of the same size on the same vehicle with one maximum load value but with different maximum permissible inflation pressures.

Closely related to FMVSS No. 109 is FMVSS No. 110, *Tire Selection and Rims B Passenger Cars*, 49 CFR 571.110, which requires that each passenger car be equipped with tires that comply with FMVSS No. 109, that tires on all cars be capable of carrying the load of that vehicle, that the rims on the car be appropriate for use with the tires, and that certain information about the car and its tires appear on a placard in the passenger car. FMVSS No. 110 also establishes rim dimension requirements and further specifies that in the event of a sudden loss of inflation pressure at a speed of 60 miles per hour, rims must retain a deflated tire until the vehicle can be stopped with a controlled braking application. FMVSS No. 110 initially became effective in April 1968.

FMVSS No. 117, *Retreaded pneumatic tires*, 49 CFR 571.117, establishes performance, labeling, and certification requirements for retreaded pneumatic passenger car tires. Among other things, the standard requires retreaded passenger car tires to comply with the tubeless tire resistance to bead unseating and the tire strength requirements of FMVSS No. 109. FMVSS No. 117 also specifies requirements for the casings to be used for retreading, and certification and labeling requirements. FMVSS No. 117 initially became effective in January 1972.

FMVSS No. 119, *New pneumatic tires for vehicles other than passenger cars*, 49 CFR 571.119, specifies performance and labeling requirements for new pneumatic tires designed for highway use on multipurpose passenger vehicles, trucks, buses, trailers and motorcycles manufactured after 1948. Under this standard, each tire has to meet requirements that are qualitatively similar to those in FMVSS No. 109 for passenger car tires. The high speed performance test in this standard only applies to motorcycle tires and to non-speed-restricted tires of 14.5-inch nominal rim diameter or less marked load range A, B, C, or D. But, FMVSS No. 119 does not contain a resistance to bead unseating test. The FMVSS No. 119 performance requirements are discussed further in Chapter II.

A tire under this standard is generally required to meet the performance requirements when mounted on any rim listed as suitable for its size designation, at the time of the tire=s manufacture, as specified by the tire and rim associations publications that are listed in the standard. Further, the tire is required to meet the dimensional requirements when mounted on any such rim of the width listed in the load-inflation tables of this standard. In addition to the permanent marking for any non-matching listed rims, each tire manufacturer is required to attach to the tire, for the information of distributors, dealers and users, a label listing the designations of rims appropriate for use with the tire. FMVSS No. 119 initially became effective in September 1974.

FMVSS No. 120, *Tire Selection and rims for motor vehicles other than passenger cars*, 49 CFR 571.120, requires that vehicles other than passenger cars equipped with pneumatic tires be equipped with rims that are listed by the tire manufacturer as suitable for use with those tires, and that rims be labeled with certain information and establishes that these vehicles shall be equipped with tires and rims that are adequate to support the fully-loaded vehicle.

FMVSS No. 120 was promulgated January 19, 1976 (41 FR 3478, January 26, 1976), and became effective in August 1976. The primary effect of Standard No. 120 is fulfillment of ' 202 of the Act by specification of the minimum load-carrying characteristics of tires not already subject to the passenger car tire and rim selection requirements of FMVSS No. 110. The rim selection requirements were limited to the use of a rim designated as suitable by the tire manufacturer for use with its product. The use of ADOT@ labeled rims was required on and after September 1, 1979.

Tire selection under FMVSS No. 120 consists of two elements. With one exception, each vehicle must be equipped with tires that comply with FMVSS No. 119 and the combined load ratings of those tires on each axle of the vehicle must at least equal the gross axle weight rating (GAWR) for that axle. If the certification label lists more than one GAWR-tire combination for the axle, the sum of the tires= maximum load ratings must meet or exceed the GAWR that corresponds to the tires= size designation. If more than one combination is listed, but the size designation of the actual tires on the vehicle is not among those listed, then the sum of the load ratings must meet or exceed the lowest GAWR that does appear.

FMVSS No. 120 also contains a requirement related to the use of passenger car tires on vehicles other than passenger cars. The requirement states that when a passenger car tire is installed on a multipurpose passenger vehicle, truck, bus, or trailer, the tire's load rating must be reduced by a factor of 1.10, i.e., by dividing by 1.10 before determining whether the tires on an axle are adequate for the GAWR. This 10 percent de-rating of P-metric tires provides a greater load reserve when these tires are installed on vehicles other than passenger cars. The reduction in the load rating is intended to provide a safety margin for the generally harsher treatment, such as heavier loading and possible off-road use, that passenger car tires receive when installed on a MPV, truck, bus or trailer instead of on a passenger car.

FMVSS No. 129, New non-pneumatic tires for passenger cars, includes definitions relevant to non-pneumatic tires and specifies performance requirements, testing procedures, and labeling requirements for these tires. To regulate performance, the standard contains performance requirements and tests related to physical dimensions, lateral strength, strength (in vertical loading), tire endurance, and high speed performance. The performance requirements and tests in FMVSS No. 129 were patterned after those in FMVSS No. 109.

The FMVSS No. 129 labeling requirements are similar to those set forth in section S4.3 of FMVSS No. 109 for size, designation, load, rating, rim size and type designation, manufacturer or brand name, certification, and tire identification number. The standard also includes temporary use and maximum speed labeling requirements and allows methods of permanent marking other than "molding" in anticipation of the difficulty of molding required information on non-pneumatic designs. FMVSS No. 129 became effective in August 1990.

D. Changes in U.S. Light Vehicle Market

Sales of light trucks (sport utility vehicles, vans and minivans, and pickup trucks) have increased steadily over the past 20 years and now account for almost half of the U.S. light vehicle market. While the number of passenger cars sold was 9.0 million units in 2000, the consumer preference for light truck vehicles continued to grow, reaching approximately 8.4 million units, just short of parity with passenger car sales. (Automotive News , 2001 Market Data Book).

Given the strong consumer demand for light trucks and that approximately 80% of these light trucks use passenger car (P-metric) tires, the net impact on original equipment passenger car tire shipments in 1999 reflects a record total of 61 million units, or a 6.8% growth over 1998's figure of 57.1 million units. Continued growth in the sales and production of light truck vehicles also drove the number of original equipment light truck (LT) tires to a record high of approximately 8.4 million units or a 25.2% increase over 1998's figures. (RMA 2000 Yearbook)

Given the increasing consumer preference for light truck use for passenger purposes, the agency believes that the tire standards being considered for passenger car tires should be extended to LT tires (up to load range E) used on light trucks. Load range E tires are typically used on SUVs and light trucks with a gross vehicle weight rating (GVWR) up to 10,000 pounds the other three tests currently required by FMVSS No. 109, namely the strength test, the bead unseating test, and the endurance test. RMA believes that these three tests have relevance to bias and bias-belted tires but little, if any, relevance to radial tires, with the single exception of the endurance test for low speed (160km/h/99 mph, or less) radial tires.

II. PERFORMANCE REQUIREMENTS

Light Vehicle Tire Standard

The agency proposed a new tire standard FMVSS No. 139 that would apply to tires used on passenger cars, multipurpose passenger vehicles, trucks, buses and trailers with a gross vehicle weight rating of 10,000 pounds or less, except motorcycles and low-speed vehicles (LSVs). The Final Rule however, will apply to all **radial** P-metric and LT tires up to load range E. The performance requirements of the current FMVSS No. 109 is retained for **bias ply** tires and FMVSS No. 119 is retained for **bias ply** tires and all tires used on vehicles with a GVWR rating greater than 10,000 pounds, and motorcycles and low-speed vehicles (LSVs). The proposed standard, commenter responses including the Rubber Manufacturers Association (RMA) proposal and the agency's Final Rule requirements are discussed below:

A. High Speed Test Requirements

Current FMVSS No. 109 High Speed Test Requirement

The current FMVSS No. 109 high speed test presses the test tire assembly against the test wheel with a load of 88% of the tires maximum load rating as marked on the tire sidewall. The test tires are inflated as specified in Table I of FMVSS No. 109, which corresponds to a pressure that is 20 kPa or 3 psi less than the maximum pressure marked on the sidewall. The tire is run for 2 hours at 50 mph and allowed to cool to $100\pm5^{\circ}$ F, followed by a readjustment of the inflation to the specified pressure. After the initial break in, the tire is tested at 75 mph for 30 minutes, 80 mph for 30 minutes, and 85 mph for 30 minutes. The tire is allowed to cool for one hour before deflating and dismounting it from the test wheel and inspecting for the failure criteria.

High Speed Test Alternatives

The agency considered three high speed alternative tire upgrade test scenarios. Alternative 1 considered adoption of the Global Tire Standard 2000 (GTS-2000) proposed by the tire industry. The GTS-2000 proposal attempted to create an internationally harmonized tire standard based on a tire's speed ratings using the same approach as ECE R 30, and the Society of Automotive Engineers (SAE) Recommended Practice J15161, *Laboratory Speed Test Procedure For Passenger Car Tires.* The agency reviewed GTS-2000 tire industry data and determined that alternative 1 was only slightly more stringent than the current FMVSS No. 109 high speed test. While taking this data into consideration, the agency developed alternative 3, a more stringent high speed test also based on the tires' speed rating. The agency conducted research tests based on tire speed ratings to determine an appropriate level of test performance criteria. When some of the high speed research test specifications in alternative 3 appeared to be overly stringent (based on a high percentage of tires failing these criteria), the agency developed alternative 2, which provided a single minimum performance level for all tires that was more stringent than alternative 1, but less stringent than alternative 3.

GTS 2000 High Speed Endurance Test (Alternative 1)

The GTS 2000 High Speed Endurance test used a procedure similar to that of FMVSS No.109, except that the test speed and tire inflation are determined by the tire's speed rating. In GTS 2000 the test tire assembly is pressed against the test wheel with a load of 80% of the tire's maximum load rating as marked on the tire sidewall. The test tires were inflated as specified in Table II-1.

Table II-1 Inflation Pressure –kPa (psi)

Speed Category	Bias-ply Tires			Radial & Bias-Belted Tires	
	Ply Rating			Standard	Extra Load (Reinforced)
	4	6	8		
L, M, N	230 (33)	270 (39)	300 (44)	240 (34)	280 (40)
P, Q, R, S	250 (36)	300 (44)	330 (48)	260 (38)	300 (44)
T, U, H,	280 (40)	320 (46)	350 (50)	280 (40)	320 (46)
V	300 (44)	340 (49)	370 (53)	300 (44)	340 (49)
W, Y	-	-	-	320 (46)	360 (52)

* For inverted flange (CT) tires, increase test inflation pressure 50 kPa (7 psi)
* For T-type temporary spare tires, the tire shall be inflated to 420 kPa. (60psi)

The tire is tested without interruption as follows:

Accelerate at a constant rate such that an initial test speed of 40 km/h (25 mph) less than the speed rating is reached at the end of 10 minutes.

10 minutes at 40 km/h (25 mph) less than speed rating
10 minutes at 30 km/h (19 mph) less than speed rating
10 minutes at 20 km/h (12mph) less than speed rating
20 minutes at 10 km/h (6mph) less than speed rating
After the test, the tire is inspected for visible evidence of failure.
The tire speed ratings (L-ZR) are provided below in Table II-2

Table II-2
Speed Ratings

Speed Rating	Speed (km/h)	Speed (mph)
L	120	75
M	130	81
N	140	87
P	150	93
Q	160	99
R	170	106
S	180	112
T	190	118
U	200	124
H	210	130
V	240	150
W	270	169
Y	300	188
ZR	Over 240	Over 150

NHTSA Speed Rated High Speed Tire Test (Alternative 3)

The agency developed alternative 3, a speed rated high speed tire test similar to, but more stringent than the GTS-2000 high speed tire tests. The tests were run by accelerating the test tire up to the initial test speed (ITS) for ten minutes, and then continuously without stopping, testing the tire at the four speeds (ITS, ITS + 10km/h, ITS + 20 km/h, and ITS + 30km/h) for twenty minutes at each step. Thus, the 20 minute step duration high speed tire test would require 90 minutes to complete (10 minutes up to ITS and four 20 minute speed steps = 90 minutes). The ITS was 30 km/h less than the speed rating of the tire. Non-speed rated tires were tested at the same speed as "Q" rated tires. Tires rated above "H" were tested at the same speed as "H" rated tires. P-metric tires were tested at 220 kPa inflation pressure, which represents an under-inflation pressure of about 8 percent from the maximum inflation pressure of 240 kPa. LT tires were held to a similar level of under-inflation. Thus, for the high speed tire test, the tire inflation pressures for load range C, D, and E were 320, 420 and 550 kPa respectively.

NHTSA Single Performance Level High Speed Tire Test (Alternative 2)

After reviewing the results of the Phase I and Phase II high speed tire tests the agency proposed alternative 2, a single performance level 90 minute upgraded high speed tire test that would be conducted in three 30 minute steps without consideration of a tire's speed rating, at the speeds of 140, 150 and 160 km/h (88, 94, and 100 mph). The agency believes that this single performance level test represents a reasonable minimum capability that all tires operating on public roads should possess. The tests were conducted at 85% of the maximum sidewall load at an inflation pressure of 220 kPa (32 psi) for standard load P-metric tires. Light truck (LT) tires were tested at inflation pressures of: 320 kPa (46 psi) for load range C tires; 410 kPa (60 psi) for load range D tires; and 500 kPa (73 psi) for load range E tires. The Alternative 2 high speed test requirements were more stringent than the current FMVSS No. 109, and Alternative 1 (GTS-2000) requirements, but less stringent than Alternative 3 requirements.

TABLE II-3

HIGH SPEED TEST COMPARISON

TEST PARAMETERS	**FMVSS 109**	**GTS-2000** **Alternative 1**	**NHTSA Single Performance Level Alternative 2**	**NHTSA Speed Rated** **Alternative 3**
Ambient (°C)	38	25	40	40
Load (%)	88	80	85	85
Inflation Pressure (kPa) P-metric Standard/Extra Load LT load range C/D/E Speed Rating (Standard/Extra) L,M,N P,Q,R,S T,U,H V W,Y	 220/260 - - - - - -	 - - 240/280 260/300 280/320 300/340 320/360	 220/260 320/410/550	 220/260 320/410/550
Test Speed* (km/h) ITS = L,M,N,P,Q R,S,T,U, H,V,W,Y	121/129/137	ITS, +10, +20, +30 90,100,110,120,130 140,150,160,170 180,210,240,270	140/150/160	ITS, +10, +20, +30 140 140,150,160,170 180
Duration (mins)	90	50	90	90

* ITS is defined as the tire's rated speed minus 30 km/h

NHTSA High Speed Tire Test Results

The agency conducted two series of high speed and endurance tire tests. In Phase I the agency tested one each of the 9 P-metric and 3 LT tire models. In Phase II the agency tested five each of the 8 P-metric and 4 LT tire models.

When the Phase I tire data was examined, it was apparent that the number of failures increased as: the test speed increased; the length of the test increased; the load increased; and the inflation pressure decreased. When the data and corresponding UTQGS temperature grades were examined; the C temperature graded tires failed with greater frequency than the B or A temperature graded tires. For the two groups of tires run to their ultimate failure, the average time to failure for each of the temperature grades were: A = 60 minutes; B = 68 minutes; and C = 49 minutes. The agency usually expects C tires to fail earlier than B tires in the high speed test, and the B tires to fail earlier than the A tires. While both the A and B tires out lasted the C tires, the agency believes the A tires failing before the B tires is an anomaly due to the particular tires in the small sample.

During Phase II testing, an additional 280 P-metric and 140 LT high speed tire tests were conducted by the agency. These tests consisted of a series of 4 different high speed tests with 5 tires of each model. All of the A Temperature grade tires except one completed their tests without a failure. Two B tire models performed as well as the A tire models, while three B tire models performed as poorly as the one C tire model. All of the LT tires tested except one completed the tests without failure. In eight cases there were discrepancies in the pass/fail outcomes of the tests for the five tires (e.g., 4 passed and 1 failed or 2 passed and 3 failed). This result led the agency to examine the manufacture quality control of the tires.

High Speed Tire Test Alternatives Analysis

The agency reviewed the Phase I and Phase II test data, and examined the percentage of tires that would pass each of the alternatives. Table II-4 presents the percentages of tires tested that would pass each of the alternative tests.

Table II-4
Percent of Tires That Passed the High Speed Alternative Tests

	Phase I Tests			Phase II Tests		
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 1**	**Alternative 2**	**Alternative 3**
P-metric tire % passed	100	100	67	100	100	63
LT tires % passed	NA	67	67	NA	100	75

The percentages in Table II-4 verify that the vast majority of tires tested can pass alternative 2 minimum performance criteria. The agency believes the test speeds selected in alternative 2 establishes a reasonable minimum performance requirement that is appropriate for safety standards of motor vehicle equipment. All the tires easily passed alternative 1 testing, which proved this alternative did not distinguish different tire performance levels. The agency also believes alternative 3 is too stringent, because it is based on a tires speed rating. Tires with higher speed ratings could fail because they would be tested beyond a minimum capability necessary for safe operation. The only tires that failed alternative 3, were those tested well beyond the interstate speed limits and the capability of many vehicles sold in the U.S.

RMA High Speed Proposal

The agency's proposed rule required that the tire be tested at 140, 150, 160 km/h for 30 minutes at each speed step with a load of 85 percent of the tire maximum load rating, with an ambient temperature of 40°C. The agency proposed inflation pressures were 220 kPa for standard load P-metric tires, 260 kPa for extra-load P-metric tires, 320 kPa, 410 kPa, and 500 kPa for LT tires load range C, D, and E, respectively.

In response to the agency proposal, RMA offered their counter proposal with a few slight adjustments in ambient temperature, break-in time, and LT tire inflation and test speed. The agency accepted the 38°C ambient temperature, and 2-hour 80km/hr break-in period, but did not change the LT tire inflation and test speeds from the agency's proposal in the final rule. The agency's proposal, RMA's proposal and the final rule test parameters are shown in Table II-5.

TABLE II-5

PROPOSED HIGH SPEED TEST REQUIREMENTS & FINAL RULE

TEST PARAMETERS	**NHTSA Proposal**	**RMA Proposal**	**Final Rule**
Ambient (°C)	**40**	38	38
Load (%)	85	85	85
Break-in @ 80km/h (mins)	**15**	120	120
Inflation Pressure (kPa) P-metric Standard/Extra Load LT load range C/D/E	 220/260 320/410/500	 220/260 **330/425/520**	 220/260 320/410/500
Test Speed* (km/h) P-metric Standard/Extra Load LT load range C/D/E	 140/150/160 140/150/160	 140/150/160 **130/140/150**	 140/150/160 140/150/160
Duration (mins)	90	90	90

RMA Confirmation Testing

RMA tested a matrix of seven P-metric and LT tires in a series of high speed and endurance tests. Four P-metric and three LT tires of various brands were tested. The P-metric tires included P235/75R15 all season tires, P215/70R15 "broad line" tires, P265/75R16 all-terrain tires, and P215/70R15 snow tires. The LT tires included LT245/75R16 LRE all-terrain/all-traction tires, LT 235/85R16 LRE all-season tires, and 31 x 10.5 R15 LRC mud tires. A total of 145 tires were tested.

The parameters used for the high speed test were identical to the agency's proposal for P-metric, except for the ambient temperature. For LT tires, RMA's test parameters were 10 km/h lower than NPRM proposal for speed, 130, 140, 150 km/h, and slightly higher inflation pressures of 330/425/520 kPa for load ranges C/D/E tires, respectively. All 42 P-metric tires RMA tested completed the 160-km/h step without any failures. Of the 32 LT tires tested, 1 tire failed to complete the 150-km/h step, and 2 tires failed to complete the 160-km/h speed step.

NHTSA Confirmation Testing

The agency conducted high speed confirmation tests at Standard Testing Laboratories Inc. (STL) and at Smithers Test Labs according to the agency's proposed test parameters. Some of the tests were conducted at an ambient temperature of 38°C and some at 40°C. When 15 P-metric and 5 LT tires tested at STL at 38°C all the tires completed the tests without failure. When STL performed the same tests at 40°C, all 15 P-metric tires completed the tests without failure, but 1 of the 5 LT tires failed. When 40 P-metric and 20 LT tires tested at Smithers at 40°C, 2 of the P-metric tires failed, and all the LT tires completed the tests without failure. This shows that these tires are designed to be substantially more robust than the current minimum test requirements parameters set forth in FMVSS No. 109. A summary of RMA and NHTSA high speed tests are provide below in Table II-6.

Table II-6
High Speed Test Results

Test Conditions	Data Source	# Tested	#Passed	#Failed	Failure Rate
P-Metric Tires					
38°C 130/140/150/160 km/hr	RMA Confirm	42	42	0	0%
38-40°C 140/150/160 km/hr	NHTSA	70	68	2	3%
38°C 140/150/160 km/hr	RMA	127	124	3	2%
Total		239	234	5	2%
LT Tires					
38°C 130/140/150/160 km/hr	RMA Confirm	32	29	3	9%
38-40°C 140/150/160 km/hr	NHTSA	25	24	1	4%
38°C 140/150/160 km/hr	RMA	62	56	6	10%
Total		119	109	10	8%

NPRM Comments

The majority of commenters who commented on the high speed test, recommended that the agency adopt a high speed test that is based on the rated speed of the tire. These commenters, who included the Alliance of Automobile Manufacturers, the ETRTO, the UN ECE Working Party on Brakes and Running Gear (GRRF) Ad Hoc tire harmonization group, and Consumers Union. Most commenters believe that it is a more stringent test and that it would provide a better chance for future international harmonization of the tire regulations. The Alliance commented that agency should consider GTS-2000 for harmonization considerations since there is no evidence of a safety problem with tires complying with ECE R30. Ford agreed with the agency that tire robustness could be increased through additional load margins, which would reduce the risk of tire failure for some customers and it suggested a high-speed test load of 105% of rated load at test speeds corresponding to the rated speeds of the tire. Public Citizen supports a high speed test based on the speed rating of the tire and argued that the NHTSA proposed high speed test fails to validate the tire industry's speed ratings by proposing to test all tires at the same speed. RMA, in its comments, indicated that it accepts the agency's high speed test parameters for P-metric tires, except the ambient temperature, for which it recommends 38°C. However, for LT tires, RMA recommends test speeds of 130, 140, 150 km/h, which are 10 km/h lower than the NHTSA proposed, along with higher inflation pressures than proposed by the agency. RMA claims that these changes are needed for LT tires to achieve the same level of stringency as P-metric tires when tested on the road-wheel tester. The UN ECE Tire Harmonization Working Group in their comments urged the agency not to select test speeds for the high speed test based on national speed limits since it would hinder global harmonization of the tire standard.

High Speed Test Final Rule

The agency has decided to adopt the proposed test speeds of 140/150/160 km/h in the final rule for both the P-metric and LT tires. The test duration adopted is 30 minutes at each speed, at 85 percent of the maximum load rating of the tire, and at the inflation pressures proposed in the NPRM. The agency has decided to reduce the ambient to 38°C for the final rule. The agency had proposed a 15-minute break-in period, because RMA indicated in prior meetings in their GTS-2000 proposal that there was no need to perform a break-in. However, RMA commented they now want to keep the same break-in period we currently require in FMVSS 109. The agency concurs and will adopt a 2-hour break-in period in the final rule, which should further enhance test repeatability.

The agency believes that this high speed test upgrade represents a slight increase of the existing test parameters and that these new test parameters do not represent a significant upgrade of the high speed test requirement. The adopted test speeds of 140, 150, 160 km/h (88, 94, 100 mph), represent a slight increase in stringency from the current FMVSS No. 109 test speeds of 75, 80, 85 mph. These speeds will likely reduce the number of UTQG temperature grade "C" tires in the marketplace. The UTQG test assigns a tire a temperature grade "C" if it fails to complete the specified roadwheel test at 100 mph. Hence, by establishing the upper limit of the test speed for the high speed test at 160 km/h (100 mph), the agency expects this test will reduce the number of these tires on the market. Based on the UTQG Standard, tires with a temperature grade "C" are less resistant to heat buildup compared to tires with grades "B" or "A," and may be more likely to fail when operated in high speed conditions. Given the typical maximum speed limits of 65-70 mph on U.S. highways and given that some vehicle manufacturers electronically restrict their vehicles top speeds at around 106 mph, drivers in the U.S. have few opportunities to operate their vehicles at speeds above 100 mph for any length of time.

The agency decided not to grant RMA's request to revise the high speed test for LT tires by reducing the test speeds and increasing the inflation pressures. The agency is not aware of any data that suggest that light trucks equipped with LT tires are operated any differently than similar light trucks equipped with P-metric tires. Tire industry data indicates that light truck owners choose LT tires as replacement tires more often than the installation rate for LT tires by the OE vehicle manufacturer. [Sources: Modern Tire Dealer, RMA]. The agency decided to adopt an ambient temperature of 38°C for the final rule, based on RMA test data that showed a 2°C increase in ambient temperature to 40°C resulted in a 2°C increase in tire temperature.

The agency's three pre-selected speeds for the high speed test are consistent with the agency's philosophy of establishing minimum performance requirements for its safety standards. Under this test regime, all tires that are applicable to the standard are tested to the same test speeds, regardless of speed rating. This does not prohibit tire manufacturers from continuing to use speed ratings as a basis for establishing the maximum design speed for tire performance. The agency does not require that tires be labeled with a speed rating. However, NHTSA is aware that vehicle manufacturers specify that consumers purchase replacement tires having the same speed rating as the original equipment tire.

B. Endurance Test Requirements

Current FMVSS No. 109 Endurance Test Requirement

The current endurance test in FMVSS No. 109 is conducted at 80 km/h (50 mph) for a total of 34 hours at loads of: 85% for 4 hours, 90% for 6 hours, and 100% for 24 hours of the maximum rated tire load, at an inflation pressure of 180 kPa (26 psi). The total distance for the current endurance test is 2720 km (1700 miles). The 50 mph test speed may have been an appropriate speed in 1968 when the standard was initially proposed for bias ply tires, but the agency believes that speed to be too low for evaluating the endurance of today's tires, given current vehicle performance capabilities and vehicle traffic speeds.

Current FMVSS No. 119 Endurance Test Requirement

The current endurance test in FMVSS No. 119 for LT tires is similar to FMVSS No. 109. The current endurance test requirements for FMVSS No. 119 is a 47-hour duration test run at the maximum inflation pressure on the tire label, at 80 km/h (50 mph) for Load Range A, B, C, and D tires at: 75% of the rated load for 7 hours, 97% of the rated load for 16 hours, and 114% of the rated load for 24 hours, and at 64 km/h (40 mph) for Load Range E tires at: 70% of the rated load for 7 hours, 88% of the rated load for 16 hours, and 106% of the rated load for 24 hours.

GTS 2000 Endurance Test

In GTS 2000, the tire industry proposed a global harmonized endurance test for passenger car radial tires rated Q and below. The test parameters included a load of 100/110/115% at a speed of 80 km/h (50 mph), for 34 hours duration at an inflation pressure of 180 kPa (26 psi). Agency testing indicates that all presently manufactured P-metric tires can pass the industry's proposed test with no failures.

Endurance Test Alternatives

The agency considered three alternative endurance upgrade test scenarios. Alternative 1 considered adoption of a protocol proposed by the Rubber Manufacturer's Association (RMA). This protocol (RMA 2000) is similar to the GTS-2000 endurance test for tires rated Q or less, with the main difference being the test speed was increased from 80 km/h to 120 km/h. The agency reviewed RMA 2000 endurance test data submitted by the tire industry and observed that all the tires passed the test. Taking this data into consideration, the agency conducted research tests to develop a more stringent set of performance criteria, alternative 3. When the endurance research test specifications in alternative 3 appeared to be overly stringent, the agency developed alternative 2, which is more stringent than alternative 1, but less stringent than alternative 3.

RMA 2000 Test Protocol (Alternative 1)

In December 2000, the RMA presented to NHTSA a test protocol, RMA 2000 that was designed and administered with the tire industry. The test protocol included the following principal parts: passenger car and light truck tire high speed tests, passenger car and light truck tire endurance tests. RMA 2000's recommended endurance test parameters are listed below:

Passenger tires – Inflation pressure - 180 kPa; Test speed - 120 km/h; Duration – 8 hours at 85% of max rated load, 8 hours at 90% of max rated load, and 8 hours at 100% of max rated load; Ambient temperature – 38°C +/- 3°C

LT tires - Inflation pressure – maximum load marked on tire sidewall; Test speed - 120 km/h; Duration – (Load Range A-D) 8 hours at 75% of max rated load, 8 hours at 97% of max rated load, and 8 hours at 114% of max rated load; (Load Range E) 8 hours at 70% of max rated load, 8 hours at 88% of max rated load, and 8 hours at 106% of max rated load; Ambient temperature – 38°C +/- 3°C

NHTSA Initial Research Endurance Test Parameters (Alternative 3)

Using data from RMA 2000 the agency developed an initial set of endurance test parameters listed below to test the endurance of current market tires:

Ambient temperature – ≥40°C

Test speed - 120 km/h;

Duration	8 hrs @ 100% of max load
	10 hrs @ 110% of max load
	32 hrs @ 115% of max load

P-metric tire inflation pressure – 180 kPa
LT tire inflation pressure – Load Range C/D/E 260/340/450 kPa

NHTSA Proposed Endurance Test Parameters (Alternative 2)

After the agency determined that the initial research parameters (alternative 3) may be too stringent the agency developed the alternative 2 test parameters which are less stringent than alternative 3 but more stringent than alternative 1. The main difference between alternatives 2 and 3 is that the tire loads are lighter, the duration is 10 hours shorter, and the LT tire inflations are higher. The NHTSA proposed endurance test parameters for alternative 2 are as follows:

Ambient temperature – $\geq$40°C

Test speed - 120 km/h;

Duration 8 hrs @ 90% of max load
10 hrs @ 100% of max load
22 hrs @ 110% of max load

P-metric tire inflation pressure – 180/220 kPa Standard/Extra Load
LT tire inflation pressure – Load Range C/D/E 260/340/410 kPa

TABLE II-7

ENDURANCE TEST COMPARISON

TEST PARAMETERS	**FMVSS 109**	**FMVSS 119**	**RMA-2000 Alternative 1**	**NHTSA Proposal Alternative 2**	**NHTSA Initial Research Alternative 3**
Ambient (°C)	38	38	38	40	40
Load (%)					
P-metric	85/90/100	-	85/90/100	90/100/110	100/110/115
LT load range C/D	-	75/97/114-	75/97/114	90/100/110	100/110/115
LT load range E		66/84/101	70/88/106	90/100/110	100/110/115
Inflation Pressure (kPa)					
P-metric					
Standard/Extra Load	180/220		180	180/220	180
LT load range C/D	-	sidewall max	sidewall max	260/340	260/340
LT load range E		sidewall max	sidewall max	410	450
Test Speed (km/h)	80	80	120	120	120
Time Schedule (hours)	4 / 6 / 24	7 / 16 / 24	8 / 8 / 8	8 / 10 / 22	8 / 10 / 32
Duration (hours)	34	34	24	40	50

NHTSA Endurance Test Results

Endurance testing was conducted on the same model Phase I P-metric tires previously tested in the High Speed Test Requirement section. Endurance tests were conducted at 120 km/h (75 mph) and 140 km/h (87 mph), with loads of 100%, 115%, and 125% of the maximum rated load for a total of 50 hours, and at inflation pressures of 160 kPa (23 psi) and 200 kPa (29 psi). At speeds of 120 km/h (75 mph) and 140 km/h (87 mph), the total test distance is 6000 km (3,728 miles) and 7,000 km (4,350 miles), respectively, which is more than twice the distance of the current passenger car tire endurance test. The same model LT tires previously tested in the high speed tests were also endurance tested at the same speeds for 50 hours with the same percentages of the maximum rated loads. The LT tires were inflated to 75% of their respective maximum inflation pressures. The results of Phase I endurance tests are summarized below in Table II-8.

Table II-8
50 Hour P-Metric Tire Endurance Test

Speed	UTQG Temp	160 kPa (23psi)		200 kPa (29 psi)	
		Ave Time to Failure	Pass/Fail	Ave Time to failure	Pass/Fail
120km/h (75 mph)	A	50 hours	4P 0F	50 hours	4P 0F
120km/h (75 mph)	B	38 hours	1P 2F	43 hours	2P 1F
120km/h (75 mph)	C	19 hours	0P 2F	35 hours	1P F
140km/h (87 mph)	A	42 hours	3P 1F	50 hours	4P 0F
140km/h (87 mph)	B	12 hours	0P 3F	25 hours	0P 3F
140km/h (87 mph)	C	17 hours	0P 2F	8 hours	0P 2F

50 Hour LT Tire Endurance Test

Speed	Load Range	C – 240 kPa (35 psi) D - 300 kPa (44 psi)		C – 290 kPa (42 psi) D - 380 kPa (55 psi)	
		Ave Time to Failure	Pass/Fail	Ave Time to Failure	Pass/Fail
120km/h (75 mph)	C	36 hours	1P 1F	48 hours	1P 1F
120km/h (75 mph)	D	32 hours	0P 1F	35 hours	0P 1F
140km/h (87 mph)	C	15 hours	0P 2F	13 hours	0P 2F
140km/h (87 mph)	D	20 hours	0P 1F	37 hours	0P 1F

Many of the P-metric tire failures occurred at the combination of low inflation pressure 160 kPa (23 psi) and speed of 140 km/h (87 mph). At a test speed of 120 km/h (75 mph) with an inflation pressure of 200 kPa (29 psi), 2 of the 9 P-metric tires (one B and one C Temperature rated) failed to complete the 50-hour test. Examination of the data in the P-metric Tire and LT Tire tables shows that the number of failures increased and time to failure decreased as: the test speed increased; and the inflation pressure decreased. Also in the P-metric table, the A temperature rated tires performed better than the B rated tires, which performed better than the C rated tires.

In Phase II Alternative 2 Endurance Test, the agency tested tires with loading conditions of 100/110/115%, which are identical to the loads recommended by the tire industry for the endurance test in GTS-2000, at 180 kPa (26 psi) inflation pressure and 120 km/h (75 mph) for 50 hours. This combination of parameters for P-metric tires represented a 50 percent increase in the speed, a 50 percent increase in the duration, and up to a 15 percent increase in the load, which constitutes a more stringent test than the current endurance test in FMVSS No. 109. In the Alternative 1 and 3 Endurance tests, the test loads were 100/115/125% and the test speed was 100 km/h (62 mph).

The LT tires were tested to the same parameters as the P-metric tires, except that the inflation pressures were 25 percent under-inflated from the maximum inflation pressure for load range C and D tires. Therefore, the test inflation pressures proposed for LT load range C and D tires subjected to the endurance test are 260 kPa (38 psi) and 340 kPa (50 psi), respectively. The load range E tires were tested at 450 kPa (65psi).

In the Phase II Endurance tests of P-metric tires, 2 (A temperature rated) tire models of the 8 tires models completed the tests without any failures in their 5 samples. The remaining tires B and C rated models experienced at least one failure in the five samples used during the tests. Most of the LT tire models had one of the five tires fail a test. The most notable exception was the Bridgestone R 273, which had all five tires fail the Alternative 3 Test.

NHTSA Proposed Endurance Phase II Testing

The proposed alternative 2 endurance test requirement is more stringent than the current FMVSS Nos. 109 and 119 requirements. But these proposed conditions are not the same as those tested in the Phase I (Table II-8) or Phase II (Table II-9). The agency believes that this lower than tested stringency represents a reasonable minimum capability that all tires operating on public

Table II-9
Phase II Endurance Test Summary

Brand	Model	UTQGS Temp Grade	Alternative 1 Test	Alternative 2 Test	Alternative 3 Test
P-Metric Tires					
Toyo	Proxes H4	A	5P* 0F#	5P 0F	5P 0F
Uniroyal	Tiger Paw Touring HR	A	5P 0F	5P 0F	5P 0F
Dunlop	D65 Touring	B	5P 0F	3P 2F	5P 0F
Goodyear	Regatta 2	B	5P 0F	1P 4F	0P 5F
BF Goodrich	Cientra Plus	B	5P 0F	3P 2F	4P 1F
Cooper	LifeLiner Classic II	B	1P 4F	2P 3F	1P 4F
Firestone	Wilderness AT	C	5P 0F	3P 2F	1P 4F
Michelin	XH4	B	5P 0F	1P 4F	1P 4F
LT Tires					
Brand	**Model**	**Load Range**	**Endurance Test 1**	**Endurance Test 2**	**Endurance Test 3**
Pirelli	Scorpion A/T	C	5P 0F	4P 1F	4P 1F
Yokohama	GeoLandar H/T	C	4P 1F	4P 1F	5P 0F
Goodyear	Wrangler HT	E	4P 1F	4P 1F	4P 1F
Bridgestone	R273 SWP 11	E	4P 1F	4P 1F	0P 5F

* P - Pass, # F - Failure
Phase II Test Conditions
Alternative 1 Test – 100/115/125% Load, 100 km/h, P-metric 180 kPa (26 psi), LT 75% of Max Inflation
Alternative 2 Test – 100/110/115% Load, 120 km/h, P-metric 180 kPa (26 psi), LT 75% of Max Inflation
Alternative 3 Test – 100/115/125% Load, 120 km/h, P-metric 180 kPa (26 psi), LT 75% of Max Inflation

roads should possess. The selected inflation pressure is also set at a level well above the warning criteria of the Tire Pressure Monitoring System (TPMS). In actual use, the agency would expect properly inflated and not overloaded tires that "pass" the endurance test to be capable of withstanding sustained use at 75 mph for more than 40 hours, since this a legal interstate speed limit in nearly all states.

Endurance Tire Test Alternatives Analysis

The agency reviewed the Phase I and Phase II test data, and estimated the percentage of tires that would pass each of the alternatives. Table II-10 presents the percentages of tires tested that would pass each of the alternative tests.

Table II-10
Percent of Tires That Passed the Endurance Alternative Tests

	Phase I Tests			Phase II Tests		
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 1**	**Alternative 2**	**Alternative 3**
P-metric tire % passed	100	89	56	100	75	25
LT tires % passed	100	100	33	100	75	-0-

All the tires easily passed the alternative 1, the RMA 2000 endurance test, which proved this alternative did not distinguish different tire performance levels. Conversely, very few tires passed alternative 3. The initial NHTSA research test parameters were deemed to be too stringent. The agency believed alternative 2 established a reasonable minimum performance requirement that would be appropriate for a motor vehicle equipment safety standard.

RMA Endurance Test Proposal

In response to the agency proposal, RMA offered their counter proposal which altered the test parameters so that: the test loads were reduced to 85/90/100 percent of maximum load, reduced the total test duration from 40 to 34 hours by changing the test increments to 4/6/24 hours; reduced the ambient test temperature to 38°C; and for LT tires reduced the test speed to 110 km/h and increased the tire inflation pressure to 82% of max which corresponds to 285/370/445 kPa for load ranges C/D/E tires, respectively. The RMA proposed is compared with NHTSA proposal and Final Rule in Table II-11 below.

TABLE II-11

ENDURANCE TEST COMPARISON

TEST PARAMETERS	**NHTSA Proposal**	**RMA Proposal**	**Final Rule**
Ambient (°C)	**40**	38	38
Load (%)	**90/100/110**	85/90/100	85/90/100
Inflation Pressure (kPa)			
P-metric	75% Max	75% Max	75% Max
Standard/Extra Load	180/220	180/220	180/220
LT	75% Max	**82% Max**	75% Max
Load range C/D	260/340	**285/370**	260/340
Load range E	410	**445**	410
Test Speed (km/h)			
P-metric	120	120	120
LT	120	**110**	120
Time Schedule (hours)	**8 / 10 / 22**	4 / 6 / 24	4 / 6 / 24
Duration (hours)	**40**	34	34

RMA Endurance Test Confirmation Testing

RMA tested 39 P-metric tires and 32 LT tires with their proposed test criteria. Two P-metric tires failed to completed the 100 percent load step (5 percent failure rate); and two LT tires tested failed to complete the 100 percent load step (6 percent failure rate).

NPRM Endurance Test Comments

The agency believes that the current endurance test is outdated and that it no longer evaluates a tire for endurance performance, given that today's tires are designed for vehicle service ranging from 30,000 miles to as much as 80,000 miles. The current endurance test in FMVSS 109 tests a tire for 2,720 km (1,700 miles) and up to 3,760 km (2,350 miles) for some LT tires at 80 km/h (50 mph), but the agency believes that these distances are too short and speeds too low for evaluating the endurance of today's tires given current vehicle performance capabilities, vehicle traffic speeds, and the relative longevity of today's tires. When FMVSS 109 was initially issued more than 30 years ago, the typical service life of a passenger car tire was 10,000 to 20,000 miles. Hence, the 1,700-mile endurance test that may have been appropriate at that time for those tires is now considered outdated given the service life of contemporary tires and vehicles. The challenge the agency faces in improving the endurance test is that any attempt to lengthen the test considerably results in concerns and complaints that it is too long and the test burden is too great for a safety standard. Also, tire aging was not a major issue in the 1960's because tires did not last long enough to deal with the long-term effects of thermal aging.

The Alliance was critical of the agency's approach for determining test parameters and indicated that the agency has not established what is a minimum level required for safety. ETRTO commented that the cumulative increase in severity (load, speed, duration, ambient temperature) is excessive and test failure modes may not reflect failure modes in regular road service.

Public Citizen believes that the agency should adopt a higher load of 100/110/115 percent for the endurance test to adequately provide for the loading conditions of the heavier commercial vehicles. They also wanted the test speeds to be at the rated speed of the tire to validate manufacturers claims. Ford recommended that FMVSS 109 test protocol be retained and revised by including an additional 48-hour step at 130% of the rated load. The agency believes that Ford's recommendation to extend the test by an additional 48 hours at a load of 130 percent of the maximum load rating of the tire is too stringent for the loading condition. Ford did not provide any data or test results to support its recommendation.

In the final rule, the agency has accepted most of the RMA proposal except for the reduced speed and higher inflation pressures recommended for LT tires. The final rule will extend the test distance to 4,080 km (2,550 miles), since the same 34 hour duration is maintained, but the test speed is increased from 80 to 120 km/h. The agency believes that the changes instituted in the final rule, represent a reasonable increase in stringency, with requirements that the vast majority of present day tires can easily already meet. Since the performance of a tire degrades with use, time and temperature, among other environmental factors, the agency believes that a test for endurance should evaluate a tire's performance over an extended period longer than 4,080 km. The agency considered RMA's recommendation for a lower test speed but we are unable to justify the need for a lower speed, given that vehicles with LT tires are operated at similar speeds as the same type of vehicles equipped with P-metric tires. RMA also argued that the test inflation pressures for LT tires need to be higher since they are more over-deflected on the roadwheel, which results in higher tire temperatures, and hence a more stringent test than a similar sized P-metric tire. The agency believes that LT tires experience higher temperatures than P-metric tires, in real-world service, thus there is no need to adjust the test stringency to make it equivalent to the thermal levels experienced by P-metric tires.

Ford indicated that the oven-aging test it proposed in its comments would represent about 2-3 years of a tire's service life.

In the final rule the ambient temperature is lowered to 38°C and the duration is reduced to 34 hours based on 4 hours at 85 percent load, 6 hours at 90 percent load and 24 hours at 100 percent load. The agency decided to establish the 85/90/100 percent schedule rather than the proposed 90/100/110 percentage after examining the failure rates in Table II-12. The inflation pressures remain unchanged from those proposed in the NPRM. The load percentages represent an upgrade for P-metric tires and are close to the load percentages currently required on the applicable LT tires.

NHTSA Endurance Confirmation Testing

The agency's tested 15 P-metric tires according to the final rule criteria except the agency used the 40 hour schedule of 8 hours at 85%, 10 hours at 90% and 22 hours at 100%. There were 14 tires that passed the test, and the one failure was a Q speed rated snow tire. This represents a failure rate of about 7%, or 0% if Q speed rated tires are eliminated from production in the future. The agency also similarly tested 5 LT tires according to the final rule criteria and all 5 of those tires passed the test. A summary of recent relevant endurance tests are provide below in Table II-12.

Table II-12
Endurance Tests Results

Test Conditions	Data Source	# Tested	#Passed	#Failed	Failure Rate
P Metric Tires					
38°C 90/100/110% load	RMA	352	302	50	14%
38°C 90/100/110% load	NHTSA	25	20	5	20%
Total		377	322	55	15%
38°C 85/90/100% load	RMA Confirm	39	32	7	18%
38°C 85/90/100% load	NHTSA	15	14	1	7%
Total		54	46	8	15%
LT Tires					
38°C 90/100/110% load	RMA	129	91	38	29%
38°C 90/100/110% load	NHTSA	8	6	2	25%
Total		137	97	40	29%
38°C 85/90/100% load	RMA Confirm	32	30	2	6%
38°C 85/90/100% load	NHTSA	5	5	0	0%
Total		37	35	2	5%

C. Low Pressure – Endurance Test / Low Pressure - High Speed Test

Currently, there are no high speed, low pressure test requirements or low pressure, endurance test requirements in the existing FMVSS Nos. 109 &119. NHTSA conducted tests on two alternative tire test procedures to evaluate tire performance at the low inflation threshold level being proposed for Tire Pressure Monitoring Systems (TPMS) for light vehicles.

The TREAD Act requires that light vehicles be equipped with a TPMS, effective November 1, 2003, to indicate to the driver when any of the tires are significantly under-inflated. When vehicles are equipped with a TPMS, the agency believes that some drivers may be less likely to check their tire pressures until the warning lamp is illuminated. As a result, the agency established in the TPMS final rule a low pressure threshold at which the low pressure warning light must be activated. The agency believes that the new upgraded tire standard, FMVSS No. 139, should include a linkage with the TPMS standard, FMVSS No.138. The TPMS standard allows each vehicle manufacturer to establish the level of under-inflation between 70-75% at which the low inflation pressure warning lamp would be illuminated.

Low Pressure Endurance Test (Alternative 1)

This test was predicated upon the notion that a low pressure test would be most appropriate on tires that have completed the endurance test because a significantly under-inflated condition for a tire is more likely to occur in a tire after several weeks of natural air pressure loss or due to a slow leak. The agency conducted 90 minute low pressure endurance test at 140 kPa (20 psi) inflation pressure, at a speed of 120 km/h (75 mph) and 100% load on the tires (2 samples of each of the 12 brands) that passed the endurance test. Similar tests were performed using the LT tires at 58 percent of their maximum sidewall inflation pressure. These low threshold values were selected based on the lowest inflation pressure at which a tire load is provided by the tire industry standardizing bodies. The results indicate that all 24 tires tested completed the test without failure.

This test provides an extra safeguard to ensure that the tires which were able to successfully complete the endurance testing can also complete an additional 90 minute test at low inflation pressure. The agency believes that this test would establish some minimum safeguard for low inflation pressure operation for a short duration. Thus, when a driver receives the TPMS warning, there is still time for him/her to take corrective action before the tire fails, assuming that the tire is not experiencing a very rapid loss of pressure.

Low Pressure High Speed Test (Alternative 2)

This proposed test provides a linkage between the proposed TPMS requirements and the proposed high speed test. While it would evaluate tires at a lower load than that specified in the Low Pressure Endurance test, the Low Pressure High Speed test would ensure that a manufacturer designs a tire so that its high speed performance would comply with the test requirements not only at recommended inflation pressure, but also at a low inflation pressure.

The 90 minute Low Pressure High Speed Test is conducted in three 30 minute speed steps of 140, 150, and 160 km/h (87, 93, and 99 mph) at 67% load and 140 kPa (20 psi) inflation pressure. A tire is considered to have passed the test if it completes the 30-minute step at 160 km/h (100 mph). NHTSA recently conducted testing of the above parameters on 8 tire brands. The results indicate that 30 percent of tires with an "S" speed rating, 63 percent of tires with an

"R" speed rating, and 75 percent of tires with a "Q" speed rating would not pass this test. However, 70 percent of tires with an "S" speed rating, and all "T" and "H" rated tires would have completed the test. The agency estimates that about 30 percent of all light vehicle tires currently on the market would fail this test.

The agency believes that this test would ensure that the tire manufacturer designs a tire so that its high speed performance would comply with high speed requirements at both the recommended inflation pressure and also at a low inflation pressure.

NPRM Low Pressure Tire Comments

In its comments to the docket on the low pressure performance test, RMA supported Alternative 1 but recommended a lower test speed, 110 km/h, for LT tires. Consumers Union also favored Alternative 1 and recommended that the test duration be increased to 4 hours so as to better simulate the distance traveled (300 miles) on a tank of fuel.

RMA also commented that it is illogical and inappropriate to run tires in a very high speed test, as proposed in Alternative 2, at such under-inflated conditions. Thermal runaway (means that the tire temperature, measured at the belt edge, did not stabilize after 30 minutes) occurred on all the tires that RMA tested to the low pressure high speed test on the curved roadwheel. The Alliance believes that the parameters for both low pressure tests are arbitrary and that there is no data to suggest that their application will result in benefits. ETRTO indicated it cannot accept the concept of the low pressure test because there is no justification to test a tire at 140 kPa.

Ford recommends that a low pressure test should be conducted on tires that have been aged in the oven aging procedure with a (50/50 blend of oxygen/nitrogen at 70°C for 14 days) it provided. The Alliance also commented that it would be better to run the low pressure test after the aging test. ECE/GRRF commented that it is opposed to such a test since the test conditions are excessive in relation to its service use. And, Public Citizen feels that the stringency of the endurance based low pressure test is questionable since all the tires passed the test, thus they recommend the low pressure high speed test.

The agency has decided to adopt Alternative 1 of the low pressure test as proposed in the NPRM, but with an ambient temperature of 38°C. Test conditions in Alternative 1 are more realistic from a vehicle operational standpoint with regard to speed. The agency disagrees with RMA's suggestion to lower the test speeds for LT tires to achieve the same stringency as for P-metric tires. LT tires typically have higher operating temperatures than P-metric tires because they are constructed differently and are heavier than P-metric tires. As a result, NHTSA believes that the test speeds of 120 km/h are appropriate for both P-metric and LT tires since these speeds are typical of highway speeds experienced by light vehicles operated on U.S. highways.

Low Pressure Confirmation Tests

In response to the NPRM, RMA conducted confirmation tests for both the proposed low pressure endurance and low pressure high speed tests. The agency also conducted confirmation tests for both proposed low pressure tests. A summary or these confirmation tests are presented in Table II-12 below.

Table II-12
RMA and NHTSA Low Pressure Confirmation Testing

Type Tire	Tester	# Tested	#Passed	#Failed	Failure Rate
Low Pressure Endurance Tests					
P-Metric	RMA	166	154	12	7%
P-Metric	NHTSA	25	25	0	0%
LT	RMA	50	45	5	10%
LT	NHTSA	11	11	0	0%
Low Pressure High Speed Tests					
P-Metric	RMA	155	121	34	22%
P-Metric	NHTSA	16	15	1	6%
LT	RMA	40	34	6	15%
LT	NHTSA	8	8	0	0%

D. Road Hazard Impact Test Requirements

Both FMVSS No 109 & 119 have a tire strength requirement, which states, "each tire will have a minimum breaking energy." The test is conducted by forcing a 19mm ($^{3}/_{4}$ inch) diameter cylindrical steel plunger with a hemispherical end perpendicularly into the tread. The breaking energy is determined by means of the following formula: W = [(FxP)/2] where W=Energy, F=Force, and P=Penetration. This test was relevant thirty years ago when the standard was issued, and all tires were bias ply. With practically all tires being radials now, it is essentially a non-test because the plunger bottoms out on the rim before penetration occurs.

The agency proposed to update the strength test by adopting the SAE J1981, Road Hazard Impact Test, as a substitute for the strength (plunger) test. The SAE J1981 test is a dynamic procedure that uses a pendulum to strike the tire. The agency believed that a replacement for the strength (plunger) test, a road hazard impact test, would be more realistic test that would simulate the tire impacting a road hazard such as a pothole or curb. The proposed minimum performance requirements were based on the current strength test values in FMVSS Nos. 109

and 119. For standard load P-metric tires, the proposed breaking energy, W is 294 joules (2600 inch-pounds) for tires with a width of 160 mm or greater, and 220 joules (1950 inch-pounds) for tires with a width less than 160 mm. The proposed breaking energy values for LT tires were derived from the current requirements in FMVSS No. 119 and are as follows: 362 joules (3200 inch-pounds) for load range C tires; 515 joules (4550 inch-pounds) for load range D tires; and 577 joules (5100 inch-pounds) for load range E tires.

The test machine positions the tire so that the striker impacts it across the width of the tire tread with a free falling 54 kg pendulum striker. The impact force must be applied at five equally spaced points around the circumference of the tire. The inflation pressures proposed were 180 kPa (26psi) for P-metric; for LT tires, 260 kPa (38 psi), 340 kPa (50 psi), and 410 kPa (59 psi), for load ranges C, D and E, respectively.

In comments to the docket, RMA recommended that a Road Hazard Impact or Plunger test is not necessary for regulatory purposes. RMA indicated that the Road Hazard test was originally developed to evaluate rims with bias ply tires and that it is not appropriate for radial tires. The Alliance recommends that the agency retain the current plunger test until a test that correlates with field performance is developed. Ford does not support the Road Hazard Impact test but recommends the current plunger test be revised for a higher load and a revised test rim to accommodate the higher load without bottoming out. ECE/GRRF says more research is needed. Most commenters questioned the need for this test for radial tires saying that passing the test was not difficult and would only be a cost burden to the industry. In addition, most commenters felt that the NPRM test was flawed in that it was not properly defined nor fulfilled its intent for testing tire-to-hazard impact worthiness.

The agency's test results from 60 tires showed no failures in the test, and post-test inspection using visual methods, shearography, and x-ray revealed no damages to any of the tires. The Road Hazard Impact test, as originally developed by SAE for a recommended practice, is a test of a tire and wheel assembly, and does not appear to be sufficiently stringent and appropriate as a replacement for the strength test.

Retain FMVSS Nos. 109 and 119 Strength Test Requirements

Therefore, the agency has decided to retain the current plunger test for P-metric tires as is required in FMVSS 109 and to adopt the current FMVSS 119 strength test requirements for LT tires, load ranges C, D, and E, into the proposed FMVSS 139. The agency plans to conduct further research in this area to develop a more appropriate test to evaluate tire strength and expects to complete rulemaking on a new or revised strength test when this research is completed.

E. Bead Unseating Test Requirements

The current resistance-to-bead unseating test was designed to evaluate how well the tire bead remains on the rim during turning maneuvers. The bead unseating test forces currently used in FMVSS No. 109 are based on bias ply tires and are typically not stringent enough for radial tires. For this reason, the industry, in GTS-2000, recommended that the test be deleted from the standard because radial tires are able to satisfy the test easily. Results from the agency's 1997-1998 dynamic rollover testing, however, provide a strong rationale for seeking to replace, rather than delete, the bead unseating requirement in FMVSS No. 109. In this testing, vehicles experienced bead unseating on three of twelve test vehicles. This bead unseating occurred during severe maneuvers. Such bead unseating in the real world poses serious safety concerns. Therefore, NHTSA proposed to replace the current bead unseating test in FMVSS No. 109 with a more stringent and appropriate test developed by Toyota, called the Toyota Air Loss Test.

The Toyota Air Loss Test was developed by Toyota to evaluate tubeless tire performance. While the current FMVSS No. 109 bead unseating test applies force in the middle of the sidewall, the Toyota Air Loss Test applies force at the tire tread surface edge. The tire tread surface edge is the actual location at which force occurs due to tire/road interface during severe vehicle maneuvers. There are two general methods for conducting the Toyota test:

1. Air Loss Bench Test Method: A tire that receives a lateral force from the ground is deformed and may be deflated as its tire bead is separated from the rim bead. The air loss test is intended to measure the tire inflation pressure at which a tire is deflated under the above condition. The test may be conducted with an actual vehicle or with a tire assembly on a test bench.
2. On-Vehicle Air Loss Test Method: When an actual vehicle is used for the air loss test, the vehicle is driven at 60 km/h along a straight course, then makes a curve with a radius of 25 meters, so that a lateral force is applied to the tire. This so-called J-turn test method is recommended because the fluctuation in input load is relatively small.

NHTSA proposed to adopt the Air Loss Bench Test Method because the test is independent of vehicle type, but the agency sought comments on both methods. This test method uses a force of 2.1 times the maximum tire load labeled on the sidewall, which is applied at the tread surface.

The wedge-shaped device applies a force on the tire, laterally, at the tread surface. This force simulates the lateral force at the tread surface a tire would experience during a severe maneuver that could produce bead unseating of the tire.

Toyota provided a description of the test apparatus and the test method used for the bench test. The apparatus includes a tire mounting hub that positions the tire vertically at an angle 5 degrees to the vertical axis, a hydraulic-powered sliding wedge-shaped block that applies force to the tire tread surface, and a control panel that includes controls for monitoring and regulating the tire's inflation pressure and a load indicator. The test procedure recommended inflating the tire to an initial inflation pressure of maximum (design) inflation pressure plus 50 kPa. Therefore, the initial inflation pressure for a P205/65R15 standard load tire rated at a load limit of 635 kg (1400 lbs.) at an inflation pressure of 240 kPa would be raised to 290 kPa. Force, using the wedge-shaped block, would be applied at a rate of 200 millimeters per second (mm/s) to a properly mounted tire and would be maintained for the duration of 20 seconds. A tire would successfully complete the test if does not suffer any [measured] air loss.

The agency recently conducted research using the Toyota test apparatus and test to verify that the recommended force levels were appropriate for a minimum safety requirement. Based on the agency's evaluation of this bead unseating method, the agency proposed 180 kPa for an inflation pressure in P-metric tires and 2.0 times the maximum tire load labeled on the tire sidewall for an application load appropriate for a minimum safety standard. The test inflation pressure for other tires are identical to the inflation pressures used in the proposed endurance test, which specifies 260 kPa, 340 kPa, and 410 kPa for LT tires load range C, D, and E, respectively.

NPRM Road Hazard Impact Test Comments

RMA commented that there is nothing inherently wrong with the concept of the current procedure and recommended that the current FMVSS 109 test be retained. However, they indicated that the test should be modified to consider the different aspect ratios of tires. The Alliance recommends that the agency use the T&RA maximum load values at the appropriate tire pressure, since the use of maximum load rating on the sidewall is unwarranted. Alliance also recommends that a test wheel specification be developed since bead unseating is also a function of the specific test wheel on which the tire is mounted. Ford recommends that the agency include a specification for a test rim to accompany the bead-unseating test since the force required to unseat a tire bead depends on the rim design. Public Citizen supports the agency's air loss bench test method but does not support the 200 mm per second force applied to the tire. Consumers Union recommends more research to develop a bead-unseating test. ECE/GRRF believes that this test does not provide any safety benefit given the expected cost of equipment to perform the test.

In the agency's 1997-98 dynamic rollover testing, we found that 3 out of 12 vehicles debeaded their tires during severe maneuvers. TREAD rollover testing again shows debeading from severe maneuvers. All of these tires pass the current bead unseating test in FMVSS 109. The Toyota test is more realistic, but based on lab testing conducted by the agency, it would not increase stringency from current FMVSS 109 test. The results of our testing to the Toyota wedge test indicate that there were no failures, which is similar to the results from testing tires to the current FMVSS No. 109.

The agency believes that tire bead unseating contributes to rollover since the rim contact with the road is one tripping mechanism that leads to a tripped rollover. Analysis of crash data from 1992 through 1996 indicates that over 7,000 rollovers are caused annually by wheel rim contact with the roadway during severe maneuvers. Even though all of these rollover crashes resulting from rim contact with the roadway may not have been the result of bead unseating, such rim contact indicates that the force exerted on the tread and tire sidewall during the maneuver was sufficient to distort the tire and expose the wheel rim edge to the road surface. Therefore, the agency believes that a bead unseating requirement has some impact on preventing rollover crashes. However, such a test needs to be developed in conjunction with vehicle- and rim-specific test parameters.

Retain FMVSS No. 109 Bead Unseating Requirements

After careful consideration, the agency has decided to retain the current requirement in FMVSS 109 for P-metric tires and extend the requirements to LT tires until further research is completed to develop a new bead unseating test. The agency plans to continue research to refine the current test, the Toyota test or some other alternative that better simulates bead unseating and then initiate rulemaking on an improved bead unseating test, if it is supported by our research results. TUV Germany recommended that the test should be dynamic test that is vehicle and rim-specific (e.g., rotating wheel), not a static test.

F. Accelerated Aging Test Requirements

During the Firestone hearings, Congress explicitly stated that there is a need for some type of aging test on light vehicle tires since most tire failures occur at a point in the service life of a tire greater than the 2720 kilometers (1700 miles) experienced by a tire in the current FMVSS No. 109 Endurance test. The agency is aware that the new proposed endurance test, that accumulates 4800 kilometers (3000 miles) on a tire, might still be considered a short-term endurance test, that does not expose the tire to the type of failures experienced by consumers at 40,000 km or beyond. There is currently no industry-wide recommended practice for accelerating the aging of tires. However, the American Society for Testing and Materials (ASTM) has recently established a Working Group to develop a long-term Durability Endurance Test Standard.

There are no current requirements for accelerated tire aging in FMVSS Nos. 109 and 119, and no industry-wide recommended practice for accelerating the aging of tires exists. The agency, solicited comments on the following three proposed alternatives for an aging tests: 1) Adhesion Test, 2) Michelin's Long-term Durability Endurance Test, and 3) Oven Aging. NHTSA had envisioned adopting one of these alternative tests, based on the comments received.

Adhesion (Peel) Test (Alternative 1)

One of the tests that provide some performance indication on the aging of a tire is the Adhesion (peel) test based on the American Society for Testing and Materials (ASTM) D413-98, *Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate*. The test methods in ASTM D413-98 cover the determination of adhesion strength between plies of fabric bonded with rubber or adhesion of the rubber layer in articles made from rubber attached to other material. They are applicable only when the adhered surfaces are approximately plane or uniformly circular as in belting, hose, tire carcasses, or rubber-covered sheet metal. The test methods used determine the force per unit width required to separate a rubber layer from a flexible substrate such as fabric.

The test is based on ASTM D413, which uses a test specimen cut from the tire and determines the force required to separate adjacent belts. The tire is conditioned using a 24-hour endurance test before the peel test is performed. The test conditions for the 24-hour test are as follows:

- Test speed: 120 km/h (75 mph); inflation pressure: 180 kPa (26 psi) for standard load tires; test load: 90%/100%/110% of the maximum load rating that is labeled on the tire; test duration: 8 hours at each load; ambient temperature: 40°C
- Adhesion test is then performed on a specimen of the tire using the ASTM D413-98 test procedure. A minimum peel strength of 30 lbs/in was proposed in the NPRM.
-

Michelin's Long-term Durability Endurance test (Alternative 2)

This test is based on a Michelin procedure for endurance testing. The test speed is 96 km/h (60 mph); inflation pressure - 275 kPa (40 psi) for standard load tires; filling gas is 50% O_2 and 50% N_2; test load is111% of the maximum load rating that is labeled on the tire; test duration is 250 hours; ambient temperature is 40°C

Oven Aging (Alternative 3)

The tire is oven-aged in an oven at 75°C (167°F) for 14 days. After this oven aging is completed, the tire is then tested to a 24-hour endurance test. The test conditions for the road wheel test are as follows:

- Test Speed: 120 km/h; inflation pressure: 180 kPa (26 psi) for standard load tires; test load: 90%/100%/110% of the maximum load rating that is labeled on the tire; test duration: 8 hours at each load; ambient temperature: 40°C

NPRM Accelerated Tire Aging Comments

The agency received several comments to the aging effects test proposals. RMA does not support an aging test because they believe it is redundant in light of the revised high speed, endurance, and low pressure tests. However, RMA indicated that the Oven Aging test is the least objectionable of the three aging proposals and provided test parameters they could support. The Alliance commented that the three aging tests cause the tire wedge region to age anaerobically (caused by the absence of oxygen), whereas NHTSA's Office of Defects Investigation data on field tires report that tires do not age anaerobically. The proposed tests may not improve real-world performance or increase safety. Ford recommends a revised version of the agency's oven aging test, using a 50/50 blend of oxygen/nitrogen as the filling gas, aged in the oven for 14 days followed by a dynamic test on the roadwheel. Ford indicated that this aging test simulates the performance of a 2-3 years oxidatively aged tire. In a meeting with Ford representatives, they stated that stowed spare tires aged three to four years fail with the same frequency, when performance tested, as tires mounted on the vehicle. Ford added that tires spend most of their operational life in a static environment. Public Citizen supports the Michelin aging test as a starting point for the proposed aging test. CU says that more research is needed to develop an aging test. ECE/GRRF could support the oven-aging proposal but it needs further investigation and could be combined with the endurance test.

RMA commented on the peel strength test alternative and recommended that the proposed adhesion peel force test not be selected because it is the least appropriate option for aging. ASTM D-413 has poor repeatability and reproducibility based on a study performed by RMA, hence for a regulatory test, it does not provide a good level of reproducibility. The test evaluates only a component of the tire, not the tire's overall performance. Peel force does not correlate with field performance or the tire roadwheel test. Data comparing failure on the endurance test to peel test force shows an inverse correlation. The peel test proposal evaluates the tire's belt compound for ultimate tensile strength in a non-aged state, and does not simulate long-term duration or field exposure.

RMA also commented that it does not support the Long Term Durability Endurance test as a regulatory test because of the test length and the inherent cost. This test was asserted to cost over $100 million more than Alternative 1 or Alternative 3. Furthermore, most of the industry has little experience with it.

The agency has decided to continue developing the oven-aging test and plans to include it in FMVSS 139 within the next 2 years when research is completed. For the oven aging, the agency plans to consider the various recommendations received to the docket comments, which include aging the tire in the oven for 14 days, inflated with a 50/50 blend of oxygen and nitrogen, at the temperature recommended by the industry, 70°C. The agency plans to consider refining the static portion of the test by using O_2/N_2 as the filling gas and also consider refining the dynamic portion of the test by developing a modified version of the endurance test, which will be conducted after the completion of the 14-day oven test. The agency will attempt to assess the performance of the test tires by comparing them with field data to see if a correlation with field data can be established.

The agency does not have test data to evaluate the performance of the improved oven-aging test to field data, and needs additional time to develop the test parameters for the combined oven aging endurance test. We do not know whether a 24-hour test, a 40-hour test or a test at some other duration would be appropriate to ensure good correlation with field data. We also have to develop a corresponding field evaluation of tires to enable us to compare through shearography analysis the level of degradation experienced by the field tires and the lab-tested tires.

The agency believes that oven-aging combined with an endurance test may enable the agency to better evaluate the aged performance of tires than a stand-alone endurance test. Oxidation is the primary mechanism behind tire aging, and temperature and the availability of oxygen are the test variables that control the oxidation rate. One of the recommendations included in reports (Clark, Govindjee) on the Ford-Firestone investigation was that the agency should consider an aging test in its regulation, in light of the known degradation of peel strength with time and temperature. The oven aging test combines thermal stresses from static and dynamic aging, both of which are important in the way a tire ages when installed on a vehicle. In the real world, the thermal stresses from static aging occur from a tire's exposure to temperatures that are typically higher than ambient because of the tire's proximity to the road surface, and also from the tire's exposure to ambient temperatures. Thermal stresses from dynamic aging occur when the tire experiences temperatures higher than ambient as a result of frictional forces between the tire and road surface. Aging takes place throughout the tire but at a faster rate at the belt edge because of the higher temperature there. The agency believes that the oven aging test plus the endurance test combine the static and dynamic components of aging that will make this test more closely resemble real world conditions.

The agency did not choose the peel test because of the limited data based on our testing, which indicated that there was no correlation between the peel strength and the endurance performance. Some of the tires that showed a low value for peel strength completed the 40-hour endurance test proposed in the NPRM, whereas another tire that had a value above the NPRM proposal failed the 40-hour endurance test. The agency agrees with RMA's comment that the peel test proposal evaluates the tire's belt compound for ultimate tensile strength in a non-aged state, and does not simulate long-term duration or field exposure.

The agency also considered the proposed 250-hour long term durability endurance test as a means of evaluating the long term endurance performance of a tire. Based on the comments the agency received, it appears that this test is a good tire development test but is inappropriate for a regulation primarily because of its cost and length. The agency is primarily concerned about the cost of this test, if it were selected as a requirement for FMVSS 139. This test requires that the tire be tested on a roadwheel for over 10 days (250 hours).

G <u>Applicability to FMVSS No.139</u>

The agency proposed in the NPRM that FMVSS 139 apply to new pneumatic tires for use on motor vehicles with a GVWR of 10,000 pounds or less, manufactured after **1975,** except for motorcycles and LSVs. Given the increasing consumer preference for light truck use for passenger purposes, the agency proposed that the NPRM also be made applicable to LT tires (load range C, D, and E) used on light trucks with GVWR of 10,000 pounds or less.

FMVSS No. 109 applies to passenger car tires, P-metric tires, used on passenger vehicles including passenger cars, trucks, and multipurpose passenger vehicles. FMVSS No. 119 applies to tires used on vehicles other than passenger cars, which include heavy truck tires, motorcycle tires, and LT tires that are used on SUVs, light trucks and vans. Many manufacturers of SUVs and pickup trucks equip these vehicles with P-metric tires as original equipment and also specify LT tires as optional equipment. However, the performance requirements for LT tires in FMVSS No. 119 are less stringent than the requirements for P-metric tires in FMVSS No. 109, even though the tires are used in the same type of on-road service on light vehicles. LT tires are required to comply with a strength test and a low speed endurance test, but are not required to be tested to a high speed performance test or a resistance to bead unseating test.

Given the increasing consumer preference for light truck use for passenger purposes, the agency believes that the safety standards established for passenger car tires should also apply to LT tires (load ranges C, D, and E) used on light trucks. Load range E tires have the highest load carrying capacity of the three LT tires that are being considered for inclusion in FMVSS No. 139 and are typically used on SUVs and trucks with a GVWR up to 10,000 pounds. Sales growth of heavier light trucks, which have GVWRs above 6,000 pounds, increased at a much faster rate than their lighter counterparts, with larger SUVs (6,000-10,000 pounds GVWR) showing an average increase of 38 percent annually between 1990 and 1998. These vehicles are more likely to use light truck tires as opposed to P-metric tires. The argument that LT tires do not need to have similar high speed and endurance capabilities as P-metric tires is not borne out by the data. Passenger cars average 12,258 miles per year during their first 6 years after purchase, whereas light trucks average 12,683 miles per year in the same time period. These data imply that owners of light trucks drive their vehicles as much as owners of passenger cars, hence, the need for LT tires to comply with similar performance requirements as P-metric tires.

RMA commented that FMVSS 139 should apply to pneumatic radial tires used on powered motor vehicles other than motorcycles, and recommended that the agency exclude temporary spares, various trailer tires, and all bias tires. The Tire and Rim Association is concerned with the automatic inclusion of special tires under FMVSS 139. They ask that ST, FI, 8-12 rim diameter and below tires be excluded and continue to be covered under FMVSS 109. Specialty Tires of America say that bias ply tires should not be included under FMVSS 139. Bias tires should be covered under FMVSS 109. Hoosier Tires and Denman, makers of small lot specialty tires of both bias and radial design (<15,000 per year), seek exemption from FMVSS 139 and wish to continue to produce tires under current regulations FMVSS 109/119. Consumer Union feels that bias ply tires should continue to be regulated under FMVSS 109/119.

The agency did not conduct any tire research on bias tires primarily because they represent a very small (less than 1 percent) segment of the market for light vehicle tires and also because they are not offered by any vehicle manufacturer on any new light vehicle sold in the U.S. However, the agency is aware of several manufacturers such as Denman and Hoosier Tires that produce bias tires for applications such as racing and off-road use. NHTSA believes that these tires may not be able to comply with the new high speed, endurance, and low pressure tests developed for FMVSS No. 139 due to the increased stringency of these tests. Therefore, the agency has decided to exempt from applicability to FMVSS No. 139 bias tires, and also special ST tires for trailers, farm implement F1 tires, and 12 rim-diameter code and below, and intends to keep them subject to either FMVSS Nos. 109 or 119.

The agency has decided to require that FMVSS No.139 apply to all new radial P-metric and LT tires load ranges C, D, and E, produced for light vehicles manufactured after 1975, including specialty and small production lot radial tires. Snow tires and other deep tread tires are also required to comply with FMVSS No. 139 since these tires are operated in the same fashion as other radial tires. Radial tires designed for use on motor vehicles should afford at least the minimum level of safety provided by this new standard.

H. Tire Selection Criteria/Load Limits

Tire reserve load refers to a tire's remaining load-carrying capabilities when the tire is inflated to the maximum inflation pressure shown on the tire sidewall and the vehicle is loaded to its gross vehicle weight rating (GVWR). When a tire is loaded to 88 percent of the maximum tire load rating labeled on the tire sidewall, the unused 12 percent is considered the reserve load of the tire. Currently, FMVSS No. 110 requires a 12 percent reserve tire load capability when a vehicle is loaded to the specified normal loading conditions, which is described as the curb weight of the vehicle plus three occupants in a vehicle with a designated seating capacity of 5 or more.

The NPRM proposed that instead of requiring that the normal load on the tire shall not be greater than 88% of the maximum tire load rating labeled on the tire sidewall, that the normal load not be greater than 85% of the tire load rating at the manufacturer recommended tire inflation pressure specified on the vehicle's tire information placard. The NPRM proposed to retain the FMVSS No. 120 de-rating factor of 1.10 for P-metric tires used on non-passenger cars. FMVSS No. 120, *Tire selection and rims for motor vehicles other than passenger cars*, requires that when a tire subject to FMVSS No. 109 is installed on a multipurpose passenger vehicle, truck, bus, or trailer, the tire's load rating must be reduced by a factor of 1.10. This 10 percent de-rating of P-metric tires in essence provides a greater load reserve when these tires are installed on LTVs. The premise for the de-rating requirement is that vehicles other than passenger cars are generally driven in harsher environments and are more often driven at or near maximum rated loads.

For light vehicles other than passenger cars using P-metric tires, the vehicle normal load requirement would be based on the 1.1 de-rated value of 85% of the tire load rating at the vehicle's placard pressure.

The agency received a variety of comments in regard to the normal load and the 1.1 de-rating factor requirements. RMA strongly supported retention of the 1.1 de-rating factor for P-metric tires used on non-passenger car vehicles, and the FMVSS 110 proposal that the normal load not exceed 85% of the tire load rating at the vehicle manufacturer's recommended tire inflation pressure listed on the vehicle's tire information placard. The Alliance urged the agency to preserve the 1.10 de-rating and maintain the present vehicle normal load requirement that the normal load not exceed 88% of the maximum load rating listed on the sidewall of the tire. The Alliance stated that NHTSA did not provide enough information to justify increasing the load reserve requirement, and said the proposed change could impact other areas of vehicle performance such as braking, corporate average fuel economy, and Noise, Vibration and Harshness. The Alliance also recommended that the agency de-link tire selection criteria from the loading used in the FMVSS No.109 high-speed test since there is no rationale for such a linkage. General Motors stated that 22% of its car and 6% of its light truck volumes based on the proposed 85% of tire load rating at placard pressure would not comply with the proposed tire selection criteria. Conversely, Public Citizen recommended that the agency require an 18 and 20 percent reserve load, since they believe a 15% reserve load does not adequately address typical loading conditions for light vehicles over 6,000 lbs. GVWR.

In the final rule, the agency decided to retain the de-rating factor of 1.10 for P-metric tires used on non-passenger car vehicles. The agency also decided to de-link tire selection criteria from the test load used in the FMVSS No. 109 high speed test. For passenger cars, the final rule requires that the vehicle normal load not exceed 94% of tire load rating at the vehicle manufacturer's recommended tire inflation pressure listed on the vehicle's tire information placard, and the same percentage is required for non-passenger car vehicles equipped with LT tires. In addition, the final rule requires that the vehicle normal load requirement for non-passenger car vehicles equipped with P-metric tires be based on the 1.1 de-rated value of 94% of the tire load rating at the vehicle's placard pressure.

The result of these final rule load criteria is presented in Table II-13.

Table II-13 Final Rule Normal Load Requirement

	Passenger Cars	LTVs
P-Metric Tires	The normal load shall not be greater than **94%** of the tire load rating at the vehicle manufacturer's recommended inflation pressure listed on the vehicle's information placard	The normal load shall not be greater than **94%** of the tire load rating at the vehicle manufacturer's recommended inflation pressure listed on the vehicle's information placard and the tire is also de-rated by a factor of 1.1. **94%/1.1 = 85%** of normal load @ vehicle's placard pressure
LT Tires	NA	The normal load shall not be greater than **94%** of the tire load rating at the vehicle manufacturer's recommended inflation pressure listed on the vehicle's information placard

The agency decided to keep the 1.1 de-rating factor for P-metric tires used on MPVs, trucks, and buses because the premise for the de-rating requirement is still valid today and also because of the unanimous support for retaining the 1.1 de-rating factor. The agency's rulemaking in 1982 stated that the 88% factor was not intended to provide a reserve load but was used to account for the differences between testing on a curved roadwheel and actual on-road flat surfaces. The historical reason for using 88% is that it represents 100% loading on a flat surface. Since the tire selection criterion is vehicle specific, the agency believes that the load should be based on the vehicle manufacturer's recommended tire inflation pressure listed on the vehicle's tire information placard, not on the maximum load rating of the tire, which is based on the maximum inflation pressure specified on the tire's sidewall.

The agency believes it is important at this time to shift from the reserve load at maximum pressure (which is tire specific) to reserve load at placard pressure because the tire loading becomes (vehicle specific). The agency is not aware of any data that links the tire pressure reserve available on light vehicles with tire failure rate on those same vehicles.

In Table II-14 the agency decided to evaluate the proposed tire normal load reserve requirements on 15 current passenger cars and 18 current LTVs. By examining the data in Table II-14, the agency determined that a 94% reserve load requirement would provide equivalency with the current 88% maximum load rating at maximum inflation pressure. When it was not equivalent, equivalency could be accomplished by changing the tire's recommended inflation pressure by a few psi.

For passenger cars and for non-passenger car vehicles equipped with LT tires, the final rule requires that the vehicle normal load be based on the load rating at the vehicle's placard pressure. The 94% figure was chosen to approximate closely the load reserve that results from the current requirement of 88% based of load rating at the tire's maximum inflation pressure.

By specifying 94% of vehicle normal load, the agency is addressing the vehicle industry's concerns that a significant number of vehicles would otherwise need to be redesigned to accommodate larger tire sizes, while aiming to reflect more accurately actual vehicle loading conditions of vehicles by requiring that each vehicle manufacturer select the appropriate reserve load for that vehicle. With a normal load requirement set at 94%, all the vehicles in Table II-14 passed the requirement except the Ford Windstar minivan. Further review of the Ford Windstar showed that this vehicle did not meet the existing FMVSS 110 normal load requirements, but it is currently not required to meet the requirements because FMVSS 110 only applies to passenger cars. Thus, the agency determined that most vehicles that meet the current FMVSS 110 reserve load requirements will be able to meet the 94% requirement with only a minor increase of 1 or 2 psi in the recommended inflation pressure to accommodate the new requirement. (Note the positive values in the last column of Table II-14).

For the final rule, the agency has also decided to retain the de-rating factor of 1.10 for P-metric tires used on non-passenger car vehicles. For non-passenger car vehicles equipped with P-metric tires, the vehicle normal load shall be not greater than the de-rated value of 94% of the tire load rating at the vehicle's placard pressure. This de-rating provides a greater load reserve when these tires are installed on vehicles other than passenger cars. For the first time, this final rule requires light trucks to have a specified tire reserve, the same as for passenger cars, under normal loading conditions.

The agency has decided to retain the de-rating factor for P-metric tires used on MPVs, trucks, and buses in part in response to widespread support from commenters. Additionally, the agency continues to believe that the premise behind the 10 percent de-rating of P-metric tires remains valid today. This premise is that the reduction in the load rating is intended to provide a safety margin for the generally harsher treatment, such as heavier loading and possible off-road use, that passenger car tires receive when installed on a MPV, truck, bus or trailer, instead of on a passenger car.

Table II-14 Light Trucks

MY	Make Model Type	GVWR (lb)	Designated Seating Capacity	Axle	GAWR (lb)	Tire Size	Placard Pressure (psi)	Max Sidewall Pressure (psi)	Max Sidewall Load Rating for Axle at Max Pressure (lb)	De-rated Max Sidewall Load for Axle at Max Pressure (lb)	Axle Load Rating at Placard Pressure (lb)	De-rated Axle Load Rating at Placard Pressure (lb)	Measured Normal Load on Axle (lb)	88% of Max Load Rating at Max Pressure (lb)	De-rated 88% of Max Load rating at Max Pressure (lb)	94% of Placard Load Rating (lb)	De-rated 94% of Placard Load Rating (lb)	Difference: 88% of Max Rating - 94% of Placard (lb)	% Load at Placard to Equal 88% of Max Load Rating (%)	Placard Change at 94% to equal 88% of Max Load Rating (psi)
2003	Chevrolet Venture Minivan	5357	7	Front	2755	P215/70R15	35	35	3240	2945	3240	2945	2570	2851	2592	3046	2769	-177	88	-4
				Rear	2755	P215/70R15	35	35	3240	2945	3240	2945	1914	2851	2592	3046	2769	-177	88	-4
2003	Pontiac Montana Minivan	5357	7	Front	2755	P215/70R15	35	44	3240	2945	3240	2945	2551	2851	2592	3046	2769	-177	88	-4
				Rear	2755	P215/70R15	35	44	3240	2945	3240	2945	1891	2851	2592	3046	2769	-177	88	-4
2003	Ford Windstar Minivan	5620	7	Front	2900	P225/60R16	35	35	3218	2925	3218	2925	2770	2832	2574	3025	2750	-176	88	-3
				Rear	2760	P225/60R16	35	35	3218	2925	3218	2925	1982	2832	2574	3025	2750	-176	88	-3
2003	Ford Windstar Minivan	5620	7	Front	2900	P215/70R15	35	35	3240	2945	3240	2945	2770	2851	2592	3046	2769	-177	88	-3
				Rear	2760	P215/70R15	35	35	3240	2945	3240	2945	1982	2851	2592	3046	2769	-177	88	-3
2003	Chevrolet Trailblazer SUV	5550	5	Front	2950	P245/70R16	32	35	4188	3807	4056	3687	2548	3685	3350	3813	3466	-116	91	-3
				Rear	3200	P245/70R16	32	35	4188	3807	4056	3687	2353	3685	3350	3813	3466	-116	91	-3

2003	Chevrolet Suburban	7000	8	Front	3200	P265/70R16	35	44	4806	4369	4806	4369	2995	4229	3845	4518	4107	-262	88	-5
	SUV			Rear	4000	P265/70R16	35	44	4806	4369	4806	4369	2875	4229	3845	4518	4107	-262	88	-5
2003	Geo Tracker	3483	4	Front	1587	P195/75R15	26	44	2954	2685	2558	2325	1520	2600	2363	2405	2186	177	102	4
	SUV			Rear	2050	P195/75R15	26	44	2954	2685	2558	2325	1481	2600	2363	2405	2186	177	102	4
2003	Hyundai Sante Fe	4870	5	Front	2645	P225/70R16	32	44	3748	3407	3572	3247	2351	3298	2998	3358	3052	-54	92	-1
	SUV			Rear	2865	P225/70R16	32	44	3748	3407	3572	3247	1755	3298	2998	3358	3052	-54	92	-1
2003	Mitsubishi Outlander	4365	5	Front	2315	P225/60R16	29	44	3218	2925	2910	2645	2246	2832	2574	2735	2487	88	97	2
	SUV			Rear	2348	P225/60R16	29	44	3218	2925	2910	2645	1754	2832	2574	2735	2487	88	97	2
2003	Kia Sorento	5467	5	Front	2822	P245/70R16	30	44	4188	3807	3938	3580	2481	3685	3350	3702	3365	-15	94	0
	SUV			Rear	3307	P245/70R16	30	44	4188	3807	3938	3580	2168	3685	3350	3702	3365	-15	94	0
2003	Toyota Highlander	4985	5	Front	2865	P225/70R16	30	44	3638	3307	3402	3093	2207	3201	2910	3198	2907	3	94	0
	SUV			Rear	2735	P225/70R16	30	44	3638	3307	3402	3093	1728	3201	2910	3198	2907	3	94	0
2003	Buick Rendezvous	5357	5	Front	2712	P215/70R16	35	44	3418	3107	3418	3107	2549	3008	2734	3213	2921	-186	88	-3
	SUV			Rear	2668	P215/70R16	35	44	3418	3107	3418	3107	1781	3008	2734	3213	2921	-186	88	-3

2003	Chrysler PT Cruiser	4425	5	Front	2384	P205/50R17	38	50	2866	2605	2756	2505	2202	2522	2293	2591	2355	-62	92	-2
	SUV			Rear	2075	P205/50R17	38	50	2866	2605	2756	2505	1574	2522	2293	2591	2355	-62	92	-2
2003	Ford F-150	6500	6	Front	3600	P255/70R16	30	44	4542	4129	4210	3827	3163	3997	3634	3957	3598	36	95	1
	Truck			Rear	3800	P255/70R16	35	44	4542	4129	4542	4129	2394	3997	3634	4269	3881	-248	88	-4
2003	Grand Cherokee	5400	5	Front	2750	P245/70R16	33	44	4188	3807	4100	3727	2376	3685	3350	3854	3504	-153	90	-4
	Laredo SUV			Rear	2950	P245/70R16	33	44	4188	3807	4100	3727	2186	3685	3350	3854	3504	-153	90	-4
2003	Jeep Liberty	5600	5	Front	2750	P235/70R16	33	44	3968	3607	3836	3487	2406	3492	3174	3606	3278	-104	91	-2
	SUV			Rear	3150	P235/70R16	33	44	3968	3607	3836	3487	2145	3492	3174	3606	3278	-104	91	-2
2003	Dodge Durango	6400	5	Front	3600	P265/70R16	35	44	4806	4369	4806	4369	2946	4229	3845	4518	4107	-262	88	-5
	SUV			Rear	3806	P265/70R16	35	44	4806	4369	4806	4369	2435	4229	3845	4518	4107	-262	88	-5
2003	Ford Explorer Sport	5580	7	Front	2735	P235/70R16	30	44	3968	3607	3668	3335	2641	3492	3174	3448	3134	40	95	1
	SUV			Rear	3325	P235/70R16	35	44	3968	3607	3968	3607	2462	3492	3174	3730	3391	-216	88	-4
2003	Dodge Grand Caravan	5500	7	Front	2850	P215/70R15	36	44	3306	3005	3306	3005	2601	2909	2645	3108	2825	-180	88	-4
	Minivan			Rear	2850	P215/70R15	36	44	3306	3005	3306	3005	1990	2909	2645	3108	2825	-180	88	-4

Table II-14 Passenger Cars

MY	Make Model Type	GVWR (lb)	Designated Seating Capacity	Axle	GAWR (lb)	Tire Size	Placard Pressure (psi)	Max Sidewall Pressure (psi)	Max Sidewall Load Rating for Axle at Max Pressure (lb)	Axle Load Rating at Placard Pressure (lb)	Measured Normal Load on Axle (lb)	88% of Max Load Rating at Max Pressure (lb)	94% of Load Rating at Placard Pressure (lb)	Difference: 88% of Max Rating - 94% of Placard load (lb)	% Load at Placard to Equal 88% of Max Load Rating (%)	Placard Change at 94% to equal 88% of Max Load Rating (psi)
2003	Chevrolet Malibu	4033	5	Front	2205	P215/60R15	29	35	2822	2580	2166	2483	2425	58	96	1
	Car			Rear	1828	P215/60R15	26	35	2822	2448	1360	2483	2301	182	101	3
2003	Chevrolet Cavalier	3662	5	Front	1997	P205/55R16	30	44	2558	2352	1960	2251	2211	40	96	1
	Car			Rear	1665	P205/55R16	30	44	2558	2352	1252	2251	2211	40	96	1
2004	Pontiac GrandPrix	4582	5	Front	2536	P225/55R17	30	44	3042	2866	2500	2677	2694	-17	93	-1
	Car			Rear	2046	P225/55R17	30	44	3042	2866	1584	2677	2694	-17	93	-1
2003	Pontiac Sunfire	3562	5	Front	1916	P195/65R15	30	35	2558	2380	1895	2251	2237	14	95	0
	Car			Rear	1687	P195/65R15	30	35	2558	2380	1213	2251	2237	14	95	0
2003	Mazda 6	4317	5	Front	2359	P205/60R16	32	44	2712	2602	2080	2387	2446	-59	92	-2
	Car			Rear	1958	P205/60R16	32	44	2712	2602	1504	2387	2446	-59	92	-2

2003	Mini Cooper	3340	4	Front	1918	P195/55R16	30	51	2402	2240	1706	2114	2106	8	94	0
	Car			Rear	1609	P195/55R16	30	51	2402	2240	1161	2114	2106	8	94	0
2003	Dodge Neon SXT	3700	5	Front	2034	P185/60R15	32	44	2218	2094	1922	1952	1968	-17	93	0
	Car			Rear	1716	P185/60R15	32	44	2218	2094	1242	1952	1968	-17	93	0
2003	Mercury Grand	5500	6	Front	2750	P225/60R16	32	35	3218	3042	2486	2832	2859	-28	93	-1
	Marquis Car			Rear	2750	P225/60R16	35	35	3218	3218	2086	2832	3025	-193	88	-4
2003	Ford Focus SE	3602	5	Front	1665	P195/60R15	32	44	2380	2292	1855	2094	2154	-60	91	-2
	Car			Rear	1745	P195/60R15	32	44	2380	2292	1285	2094	2154	-60	91	-2
2003	Ford Mustang	4365	4	Front	2306	P225/55R16	35	44	2954	2954	1996	2600	2777	-177	88	-4
	Car			Rear	2117	P225/55R16	35	44	2954	2954	1526	2600	2777	-177	88	-4
2002	MR-2 Spyder	2695	2	Front	1180	P185/55R15	26	44	2038	1720	1100	1793	1617	177	104	6
	Car			Rear	1625	P185/55R15	32	44	2270	2160	1454	1998	2030	-33	92	-1
2002	Nissan Altima	4202	5	Front	2249	P205/65R16	29	44	2954	2668	2112	2600	2508	92	97	2
	Car			Rear	1969	P205/65R16	29	44	2954	2668	1481	2600	2508	92	97	2

2002	Ford Taurus	4684	5	Front	2552	P215/60R16	30	44	2954	2734	2339	2600	2570	30	95	1
	Car			Rear	2132	P215/60R16	30	44	2954	2734	1453	2600	2570	30	95	1
2002	Dodge Stratus	4142	5	Front	2308	P205/65R15	30	44	2800	2594	2200	2464	2438	26	95	1
	Car			Rear	1884	P205/65R15	30	44	2800	2594	1424	2464	2438	26	95	1
2002	Suzuki Esteem	3219	5	Front	1731	P185/60R14	30	35	2094	1932	1643	1843	1816	27	95	1
	Car			Rear	1554	P185/60R14	30	35	2094	1932	1162	1843	1816	27	95	1

III. TARGET POPULATION

Safety Problems Associated With Tires

There is no direct evidence in NHTSA's crash data files that points to defective or sub-standard tires as the cause of a particular crash. The closest data element is "flat tire or blowout". Even in these cases, crash investigators do not record what caused the tire failure. Tire failures, especially blowouts, are typically associated with rollover crashes.

It is possible that a combination of lesser quality tires (lesser quality being defined here as designs that do not adequately dissipate heat, which causes the tire to rapidly build-up heat which ultimately causes the tire failure) being operated in an under-inflated state and/or an overloaded state could account for many of the tire failures, since both under-inflation and overloading increase heat build-up in the tire. Severe under-inflation coupled with an emergency steering maneuver could cause the tire to "de-bead," i.e., separate from the rim, which could "trip" the vehicle and cause it to roll over.

The Target Population for General Tire-Related Crashes

The agency examined its crash files to gather available information on tire-related problems causing crashes. The 1977 Indiana Tri-level study investigated 2,258 crashes on-site and 420 crashes in-depth and found 3 cases (0.1 percent) where tire blowout was a certain or probably cause of the crash. However, there is no information as to what caused the blowout in the crash investigations.[1] At the time of the study, radial tires

[1] **Tri-level Study of the Causes of Traffic Accidents: Executive Summary,** Treat, J.R., Tumbas, N.S., McDonald, S.T., Shinar, D., Hume, R.D., Mayer, R.E., Stansifer, R.L., & Castellan, N.J. (1979). (Contract No. DOT HS 034-3-535). DOT HS 805 099. Washington, DC: U.S. Department of Transportation, NHTSA.

represented only 12% of the tire population and now they are more than 90%, including all tires on new light vehicles. Therefore, the 1977 results may not be applicable in today's tire environment.

The National Automotive Sampling System - Crashworthiness Data System (NASS-CDS) has trained investigators that collect data on a sample of tow-away crashes around the country. These data can be extrapolated to national estimates. The NASS-CDS contains on its General Vehicle Form the following information: a critical pre-crash event, vehicle loss of control due to a blowout or flat tire. This category only includes part of the tire-related problems causing crashes. This coding would only be used when the tire went flat rapidly or there was a blowout which caused a loss of control of the vehicle, resulting in a crash.

NASS-CDS data for 1995 through 1998 (with predominately radial tires) were examined and average annual estimates are provided below in Table III-1. Table III-1 shows that there are an estimated 23,464 tow-away crashes caused per year by blowouts or flat tires. Thus, about one half of one percent of all crashes are caused by these tire problems. The denominator for the right hand column of Table III-1 is all crashes by the vehicle type in the row. When these cases are broken down by passenger cars versus light trucks, blowouts cause more than three times the number of crashes in light trucks (0.99 percent) than in passenger cars (0.31 percent). Blowouts cause a much higher proportion of rollover crashes (4.81 percent) than non-rollover crashes (0.28 percent); and the rate in light trucks (6.88 percent) is more than three times the rate in passenger cars (1.87 percent).

Table III-1

	Tire Related Cases	**Percent Tire Related**
Passenger Cars Total	*10,170*	*0.31%*
Rollover	1,837 (18%)	1.87%
Non-rollover	8,332 (82%)	0.26%
Light Trucks Total	*13,294*	*0.99%*
Rollover	9,577 (72%)	6.88%
Non-rollover	3,717 (28%)	0.31%
Light Vehicles Total	*23,464*	*0.51%*
Rollover	11,414 (49%)	4.81%
Non-rollover	12,049 (51%)	0.28%

Estimated Annual Average Number (1995-98 NASS) and Rates of Blowouts or Flat Tires Causing Tow-away Crashes

Table III-2 shows the estimated number of fatalities and injuries in those cases in which a flat tire/blowout was considered the cause of the crash[2]. There are an estimated 414 fatalities and 10,275 non-fatal injuries in these crashes.

In 2000, there were 16,352,041 crashes[3] involving all motor vehicles. About 94 percent (15,371,000) of these involved passenger cars or light trucks If we assume that 0.51 percent of all crashes are due to flat tires or blowouts, there were an estimated 78,392 crashes per year involving flat tires or blowouts on passenger cars or light trucks.

[2] Since CDS typically underestimates the number of fatalities, a factor of 1.163 was developed based on the number of occupant fatalities in FARS divided by the number of occupant fatalities in CDS for those years. The actual estimate of flat tire/blowout fatalities were multiplied by the1.163 factor.

[3] "The Economic Impact of Motor Vehicle Crashes, 2000", NHTSA, May 2002, DOT HS 809 446, Page 9.

We examined these crashes by speed limit of the highway, knowing that the heat build-up is related to speed. Of the 414 fatalities, 306 (74 percent) occurred on highways with posted speed limits of 55 mph or higher. Of the 10,275 injuries, 6,590 (64 percent) occurred on highways with posted speed limits of 55 mph or higher.

Table III-2
Injuries/Fatalities in Crashes Caused by
Flat Tire/Blowout

	Non-fatal AIS 1	Non-fatal AIS 2	Non-fatal AIS 3	Non-fatal AIS 4	Non-fatal AIS 5	Fatalities
Number of Injuries	8,231	1,476	362	155	51	414

The Fatality Analysis Reporting System (FARS) was also examined for evidence of tire problems involved in fatal crashes. In the FARS system, tire problems are noted after the crash, if they are noted at all, and are only considered as far as the existence of a condition. In other words, in the FARS file, we don't know whether the tire problem caused the crash, influenced the severity of the crash, or just occurred during the crash. For example, (1) some crashes may be caused by a tire blowout, (2) in another crash, the vehicle might have slid sideways and struck a curb, causing a flat tire which may or may not have influenced whether the vehicle rolled over. Thus, while an indication of a tire problem in the FARS file gives some clue as to the potential magnitude of the tire problem in fatal crashes, it can neither be considered the lowest possible number of cases nor the highest possible number of cases. In 1995 to 1998 FARS, 1.10 percent of all light vehicles were coded with tire problems. Light trucks had slightly higher rates of tire problems (1.20 percent) than passenger cars (1.04 percent). The annual average number of vehicles with tire problems in FARS was 535 (313 in passenger cars and 222 in light trucks). On average, annually there were 647 fatalities in these crashes (369 in passenger cars and 278 in light trucks). Thus, these two sets of estimates seem reasonably consistent: 647 fatalities in FARS in crashes in which there was a tire problem and 414 fatalities from CDS, in which the flat tire/blowout was the cause of the crash.

Geographic and Seasonal Effects

The FARS data were further examined to determine whether heat is a factor in tire problems (see Table III-3). Two surrogates for heat were examined: (1) in what part of the country the crash occurred, and (2) in what season the crash occurred. The highest rates occurred in light trucks in southern states in the summer, followed by light trucks in northern states in the summer, and by passenger cars in southern states in the summer. The lowest rates occurred in winter and fall. The denominator is all passenger cars or light trucks in fatal crashes by season. It thus appears that tire problems are heat related.

Table III-3

Geographic and Seasonal Analysis of Tire Problems (Percent of Vehicles) in FARS with Tire Problems

	Passenger Cars	Light Trucks	All Light Vehicles
Northern States			
Winter	1.01%	0.80%	0.94%
Spring	1.12%	1.01%	1.08%
Summer	0.98%	**1.46%**	1.15%
Fall	1.04%	0.93%	1.00%
Southern States			
Winter	0.87%	0.99%	0.92%
Spring	1.09%	1.27%	1.16%
Summer	**1.31%**	**1.99%**	1.59%
Fall	0.89%	1.07%	1.00%

Winter = December, January, February.
Spring = March, April, May
Summer = June, July, August
Fall = September, October, November.

Southern States = AZ, NM, OK, TX, AR, LA, KY, TN, NC, SC, GA, AL, MS, and FL.
Northern States = all others.

Tire Problems by Tire Type and Light Truck Type

The agency also examined tire problems in the NASS-CDS database from 1992 to 1999 by types of light trucks and vehicle size to determine whether LT tires used on light trucks had more tire problems than P-metric tires. Table III-4 provides the results of this analysis, showing the unweighted number of cases. The unweighted numbers are used since in this case, as sometimes happens when NASS data are broken up into a small number of cells, the results obtained using weighted numbers do not appear to be logical.

LT tires are used on the vehicle classes we have identified for this analysis as Van Large B and Pickup Large B groups of vehicles. These groups of vehicles typically represent the ¾-ton and 1-ton vans and pickups. P-metric tires are used on most other light trucks. The data indicate that the average percent of the light trucks in NASS-CDS that have an LT tire problem is 0.84 percent (10/1,186), while the average percent of the light trucks that have a P-metric tire problem is 0.47 percent (53/11,226). Of course larger pickups and vans are also the vehicles that carry the heavier loads and may be more likely to be overloaded than other light trucks. In addition, these heavier vehicles are often used at construction sites and may be more apt to pick up nails resulting in flat tires. Thus, there may well be driver behavior issues that drive the percentage of tire problems up for these larger trucks, rather than any qualitative difference between P-metric and LT tires.

Table III-4

Tire Problems by Light Truck Vehicle Type
1992 to 1999 NASS-CDS Data
Unweighted Data

Light Truck Type	Number of Cases with a Tire Problem	Total Number of Cases	Percent of Cases with a Tire Problem
Van – Compact	11	2,125	0.52
Van – Large A	3	431	0.70
Van – Large B	4	501	0.80
Pickup – Compact	13	3,155	0.41
Pickup – Large A	7	1,849	0.38
Pickup – Large B	6	685	0.88
SUV – Compact	16	3,147	0.51
SUV – Large	3	519	0.58
Total	63	12,412	0.51

The Van – Large A group includes vehicles like the Ford Econoline - 150
The Van – Large B group includes vehicles like the Ford Econoline – 250/350
The Pickup – Large A group includes vehicles like the Ford F-150
The Pickup – Large B group includes vehicles like the Ford F-250/350

Crashes Indirectly Caused by Tire Problems

There are also crashes indirectly caused by tire related problems. If a vehicle stops on the side of the road due to a flat tire, there is the potential for curious drivers to slow down to determine the reason for the stopped vehicle. This can create congestion, potentially resulting in a rear end impact further back in the line of vehicles when some driver isn't paying enough attention to the traffic in front of him/her

Another crash type indirectly caused by tire problems involve crashes relating to incidents on the road when a driver is in the act of changing a tire on the shoulder of the road. Sometimes drivers changing tires are struck (as pedestrians) by other vehicles. This phenomena is not captured in NHTSA's data files, but there are three states

(Pennsylvania, Washington, and Ohio) which have variables in their state files which allow you to search for and combine codes such as "Flat tire or blowout" with "Playing or working on a vehicle" with "Pedestrians". An examination of these files for calendar year 1999 for Ohio and Pennsylvania and for 1996 for Washington found the following information shown in Table III-5.

Table III-5
State data on tire problems and pedestrians

	Ohio	**Washington**	**Pennsylvania**
Pedestrians Injured	3,685	2,068	5,226
Pedestrians Injured While Playing or Working on Vehicle	50 (1.4%)	27 (1.3%)	56 (1.1%)
Pedestrians Injured While Working on Vehicle with Tire Problem	0	2	0
Total Crashes	385,704	140,215	144,169
Crashes with Tire Problems Not Coded in GES	862 (0.22%)	1,444 (1.03%)	794 (0.55%)

The combined percent of total crashes with tire problems of these three states (3,100/670,088 = 0.46 percent) compares very favorably with the NASS-CDS data presented in Table III-1 of 0.51 percent. The portion of pedestrians coded as being injured while working on a vehicle with tire problems is 2/10,979 = 0.018 percent. Applying this to the estimated number of pedestrians injured annually across the U.S. (85,000 from NASS-GES), results in an estimated 15 pedestrians injured per year due to tire problems. The agency does not have data to estimate how many of the pedestrian injuries could be reduced by having better tires.

IV. BENEFITS

There are many factors that influence crashes caused by flat tires/blowouts, including speed, tire pressure, and the load on the vehicle. Blowouts to the front tire can cause roadway departure, or can cause a lane change resulting in a head-on crash. Blowouts in a rear tire can cause spinning out and loss of control. As discussed in the target population section, a target population can be estimated for tire problems, but the agency doesn't know how many of these crashes are influenced by tire design or under-inflation. The agency's best estimates of these effects are discussed below.

The target population is 414 fatalities and 10,275 non-fatal injuries that occur annually in a total of 78,392 crashes in which the cause of the crash is a flat tire/blowout in a light vehicle. Puncture is the most common reason for a blowout. However, there are also many cases where a tire is punctured, loses air, and then fails later after being driven a distance under-inflated. There are no data on whether the tire failed because of a nail puncture, hitting a curb, de-beading, low tire pressure with or without overloading, or normal wear out. Thus, it is difficult to estimate what percent of the tire problem crashes are the result of tire failure modes that might be affected by this proposal.

In the Tire Pressure Monitoring System (TPMS) analysis, the agency assumed that under-inflation is involved in 20 percent of the cases that caused the crash. The agency assumed that the influence that under-inflation has on the chances of a blowout are influenced by both tire pressure and the properties of the tire. Thus, we assumed that better inflation would take care of 50 percent of these cases and we assumed that better tires could take care of 50 percent of this problem. Thus, 41 fatalities (414 x .2 x .5) and 1,028 injuries in 7,839 crashes were assigned to the TPMS rule. This leaves the target population for this rule at 373 fatalities and 9,247 injuries occurring in 70,553 crashes.

The impact of the final rule will be to increase the strength, endurance, and heat resistance of tires by strengthening the standards on high-speed tests, endurance, and by adding a low-pressure endurance test. The impact of strengthening the standards is that certain tires would be eliminated from the U.S. marketplace.

Table IV-1 shows our estimate of how many present-day tires would fail the combination of high speed, endurance and low pressure-endurance tests. Each tire has to pass all three tests to be considered as passing the final rule requirements. The agency will examine a range of 5 to 11 percent of tires failing.

Table IV-1
Percentage of Tires Failing Performance Tests

Data Source	High Speed Test	Endurance Test	Low Pressure Endurance Test	Combined Tests
		P-Metric Tires		
RMA*	2%	18%	7%	25%
NHTSA	3%	2%**	0%	5%
Combined Estimate	2%	3.5%	6%	11%
		LT Tires		
RMA*	10%	6%	10%	24%
NHTSA	4%	0%	0%	4%
Combined Estimate	7%	3%	8%	17%
		Combined Tires		
NHTSA	3%	2%	0%	5%
Combined Estimate	2%	3.5%	6%	11%

* Some of the test data provided by RMA were, in NHTSA's opinion, not representative of all tire sales. The estimates provided in the table are the percentage of failures in the tires tested by RMA. In our opinion, these percentages are higher than an average of all tires being produced. The "Combined Estimate" includes NHTSA's judgment on the how representative the tests are.

** The actual failure rate is 7 percent (see Table II-12). It represents the failure of one Q-rated snow tire. Since only 2 percent of all tires sold are snow tires, we believe that 2 percent is more realistic failure rate when considering all tire sales.

While it is intuitively correct to upgrade the tire standards (i.e., stronger tires will lead to less blowouts, tire failures, and de-beading problems), the agency cannot make a direct link between the present standard and the upgraded performance requirements of the final rule, in terms of tire failures. It would appear that the final rule will have minimal benefits, since it appears that the vast majority of tires (89 to 95 percent) presently on the market can pass all of the performance requirements and the failures are mainly at the end of the test. Most of the failures were found when the tires were inspected after the test had been completed, without a loss in pressure.

The problem the agency has in estimating benefits is that, the agency knows intuitively that any improvement in how tires perform in these tests will result in improved safety, but the agency does not know how to translate the test improvement and tire upsizing into real world benefits. Furthermore, it is hard to estimate what improvement might occur if variability in tires were reduced in the real world. The question is, do these upgraded requirements result in tires avoiding a heat-related or structure related problem long enough that the tire is discarded because of a worn tread or some other reason before it fails.

We have made an estimate of the target population. There are an estimated 373 fatalities and 9,247 injuries occurring in 70,553 crashes in the target population. However, we do not have a good estimate of effectiveness. In the Preliminary Economic Assessment[1], we compared the time at which tires failed the test to the proposed length of the test. As an example, in the NPRM, the average failing tire in the high-speed test failed at 84 minutes in the 90-minute test. We assumed that the average tire would need to improve by 7 percent (90/84 – 1). Based on our judgment of how hard it would be to meet the tests proposed in the NPRM, we estimated that there would be a 22 percent reduction in flat tires/blowouts for those tires that failed the proposed NPRM tests.

Now, at the test severity in the final rule, all of tires were run the full 90 minutes in the high-speed test and almost all of the tires ran the full 34 hours in the endurance test.

[1] "Preliminary Economic Assessment, FMVSS No. 139, Proposed New Pneumatic Tires for Light Vehicles", NHTSA, October 2001. (Docket No. 8011-29).

After the test is concluded, the tires are inspected; and it was determined that some of the tires failed the test, even though they never lost pressure. The results of these tests indicate to us that the necessary improvement in safety to meet the final rule tire upgrade requirements will be much smaller than we estimated in the NPRM, when more stringent or difficult requirements were proposed. To show the potential magnitude of the benefits, we will assume that there could be a 5 to 10 percent reduction in flat tires/blowouts for those tires not passing the test. At these levels, the total potential improvement would be 19 to 37 lives saved (373 * .05 to .10) and 462 to 925 injuries avoided (9,247 * .05 to .10) occurring in 3,528 to 7,055 crashes (70,553 * .05 to .10), if only those tires in the target population were those that needed improvements. If the tires having flats and blowouts were a random selection of all tires and only benefits accrued to those tires currently not passing the final rule performance requirements (5 to 11 percent), then the benefits would be 1-4 lives saved (19 * 0.05 to 37 * 0.11) and 23 to 102 injuries reduced (462 * .05 to 925 * .11) occurring in 176 to 776 crashes (3,528*.05 to 7,055*.11).

We can distribute the 176 to 776 crashes into the following categories shown in Table IV-2. There are almost two injured persons per injury crash. This distribution is important for the cost per equivalent life saved analysis in Chapter VII, and to estimate the cost savings for property damage only crashes.

The benefit of reducing property damage only crashes is in reducing property damage and travel delay. Based on a NHTSA study[2], the average value of reducing a property damage crash is $2,287. Thus, the total benefit of reducing the property damage only crashes is $373,000 ($2,287 * 163) to $1.64 million ($2,287 * 717).

Table IV-2
Distribution of Benefits into Crash Severity Categories

Fatal Crashes	Injury Crashes	Property Damage Only Crashes	Total Crashes
1	12	163	176
4	55	717	776

There would be additional benefits in non-crash situations. When someone gets a flat tire, and does not have a crash, there is a travel delay. There could be significant benefits in these cases, because a stronger tire would have fewer flats and blowouts, but the agency can't estimate the difference in their occurrence.

The agency is not aware of any data that relates a tire's available tire reserve load on light vehicles, with tire failure rates. In 1981, the agency did a study and determined that there was no correlation between increased tire reserve load and vehicle crashes. We recently received a petition and two congressional letters requesting that we update the previous study and make a new determination of any benefits for tire reserve load. The agency has decided to update the study, and in December 2002, sent letters to all major tire and vehicle manufacturers requesting relevant data to conduct the new study. Thus, the

[2] "The Economic Impact of Motor Vehicle Crashes, 2000", NHTSA, May 2992, DOT HS 809 446, page 9.

agency cannot at this time quantify the benefit of changing the vehicle's available tire reserve load. For most vehicles this change will result in a small increase in the vehicle's available tire reserve load.

V. COSTS AND LEAD TIMES

Tire Upgrade Costs

We estimate that 5 to 11 percent[1] of tires will not be able to pass the tests required in the final rule and those tires will not be able to be sold. We assume in this analysis that these tires will be redesigned, at a cost to improve the tires, to pass the test. However, it is also possible that these tires might just drop out of the market and the sales and market share of other currently passing tires may increase. While tires with higher speed ratings, which are more expensive, are passing the tests, there does not seem to be a relationship between cost and passing the tests for the less expensive tires. Thus, it is plausible that there could be no additional expense to consumers if tires not passing the tests were replaced in the market by tires that cost the same and pass the test. For the most part, we don't believe this will happen because tire manufacturers will want to replace their non-passing tires in that same market niche with other tires that pass the final rule.

In the Preliminary Economic Assessment, the agency estimated the costs of redesigning tires to meet the proposal using two different methodologies. First, we assumed that some of the tires rated C for temperature resistance would have to be upgraded to B rated tires. The agency attempted to determine the difference in prices between two tires that appear to be essentially the same in all characteristics, except one is a B-rated tire and the other is a C-rated tire for temperature resistance. However, it appears that there are very few cases where every notable

[1] As discussed earlier in the analysis, using only NHTSA's test results would result in about 5 percent of the tires having to be redesigned so that they are less susceptible to heat build-up. Using only RMA's data, 25 percent of the tires tested (not a weighted percentage of tires sold in NHTSA's opinion) would not pass the test. The agency's best estimate after reviewing all of the data (NHTSA's and RMA's), and weighting the data by how well they represent the fleet, is that about 11 percent of the tires would not pass the final rule's tests. This analysis will examine the impacts of 5 to 11 percent of tires not passing the final rule's tests.

attribute (comparing tire size, warranty provided, treadwear, and traction) of two different tires are the same except for the temperature resistance rating. The agency estimated that the difference in price between a C-rated tire that may fail the proposed standard and a B-rated tire that would pass the proposed standard was $3 per tire (in 2001 dollars). This estimate was based on two considerations. First, the amount by which these tires were failing the proposed tests was not large and the agency assumed that the changes to the tire to make them pass the tests would also not be large. Second, the agency attempted to get a sense for pricing in the tire market and what it means to pricing to be a C-rated versus B-rated tire. This difference in price did not appear to be large. Comments were requested on this estimate, but none were provided.

A second countermeasure for meeting this test would be to increase the tire size used on the vehicle to get more tire reserve load. The incremental cost of increasing a tire size depends upon the initial size and price of the tire. For the smallest/cheapest P-metric tires, increasing a full tire size increases price by about $1 per tire. For the larger P-metric tires, increasing a full tire size increases price by $3 to $5 per tire and for an LT tire, the price increase would be $5 to $10 per tire. However, many of the failing tires were close to meeting the final rule and it is not at all certain that a full tire size would be needed to meet the final rule.

Since the agency has reduced the stringency of the tests for the final rule, in comparison to the NPRM, it is likely that the changes made to the failing tires will be minor and cost less than our NPRM estimate of $3 per tire. Based on test data indicating when the tires were failing the proposed NPRM tests, the agency estimated that the average C-rated tires would need to be improved by 7 percent to meet the proposal. At the NPRM test level, the average C-rated tires were failing the 90-minute high-speed test at 84 minutes. The agency looked at the tires failing the final rule tests and found that almost all of the tests were run to completion, but the tires were failed upon examination of the tires after the test. Thus, the failures were very close to passing and it would be anticipated that the costs to make the failing tires pass the test, would be small.

Comments were requested upon what countermeasures would be needed to pass the tests and their costs. The Rubber Manufacturers Association provided comments indicating that additional materials would be needed for modified tires. Those materials might include different rubber compounds, more plies, reinforcements in the tire, and nylon caps. RMA did not provide an average incremental cost per tire to meet the proposal. No commenter indicated that a larger tire size was a likely countermeasure and since the needed tire changes probably are not large, the agency also believes that a larger tire size is not a likely countermeasure for the final rule.

In their docket comments, the Rubber Manufacturers Association (RMA)[2] provided estimates of the annual cost under the NPRM and under the RMA proposal. The agency's analysis of these costs will focus on three cost components, since many of the proposed/discussed tests are not included in the final rule. The total of these three costs under the RMA proposal was $216 million. First, RMA estimated about $8 million for additional testing, second, they estimated $137 million for additional materials for modified tires, and third, they estimated $71 million for "additional conversion costs for modified tires". A discussion with RMA (see NHTSA Docket 8011 for an ex parte memorandum on this discussion) revealed what costs were included in the additional conversion costs. These costs included equipment changes, alterations, compounds kept ready for use, longer cure times, perhaps more time in the process to add more plies to the

[2] See RMA comments of June 5, 2002 to Docket No. 00-8011-64, page 40.

tire, and the lost productivity during the time to changeover to new tires. In the agency's opinion, the only costs that should be included from this list as incremental costs attributable to the final rule are the additional time it takes to make a passing tire (longer cure times or the time it takes to add more plies to the tire). Lost productivity, equipment changes, and alterations may occur in the first year of changeover, but will not continue on an annual basis. We do not have a breakdown of those costs ($71 million) to determine which ones to include and exclude.

The RMA docket submission estimated similar costs for the NPRM tests for the same three components. These totaled $390 million, including $242 million for materials, $136 million for conversion costs and $12 million for additional testing. In their docket submission, RMA estimated the average failure rate for new tires meeting the NPRM proposal was about 35 percent.[3] With 287 million tires made per year and 35 percent failing, the average cost per tire, including all of the RMA estimated costs would be $3.90 per tire ($390 million /(287 million * .35 = 100 million failing tires)). If the conversion costs were not included, the cost per tire would be $2.54 per tire. To NHTSA, this verifies our NPRM estimate of $3 per failing tire.

However, RMA did not estimate what they believed the failure rate for tires would be when tested to the RMA proposed tests. Thus, the agency could not use the RMA data to estimate the cost per failing tire. The final rule contains different or less stringent parameters than the NPRM proposal. Thus, the costs per failing tire should be much less than our previous estimate of $3 per tire. As an example, in the NPRM, the average failing tire in the high-speed test failed at 84 minutes in the 90-minute test. Now, at the test severity in the final rule, all of tires were run the

[3] Based on the footnote on page ii of the RMA submission, the mid-point of the failure rates for passenger cars tires is 34 percent and for light truck tires is 51.5 percent. Weighting these by 95 percent P-metric sales and 5 percent LT sales, results in a weighted failure rate of about 35 percent.

full 90 minutes, but after they were taken off the wheel, a few tires failed because of observed problems with cracks in the bead or other problems. All of the performance tests contain parameters which are different or not as stringent as proposed. The change in the failure rate indicates this (in the NPRM, we estimated 33 percent of the tires would fail, now we estimate 5 to 11 percent in the final rule), but also the degree of failure is less for the final rule than in the tests proposed for the NPRM. Because the incremental improvement needed is reduced, less material will be required to make the failing tires pass the test.

It is difficult for the agency to estimate the incremental cost, but we believe it is in the range of $0.25 to $1.00 per failing tire. On an average tire basis, considering those tires that are estimated to currently fail the final rule tests, the average cost is $0.01 per tire ($0.25*.05) to $0.11 per tire ($1*.11).

Since only a portion of new vehicles are equipped with tires that would not meet the final rule, we can estimate the average price increase for new vehicles by comparing those vehicles that would get improvements at $0.25 to $1 per tire with those vehicles whose tires and prices wouldn't change.

The agency estimates that about 85 percent of the light vehicle fleet (passenger cars, pickups, SUVs and vans) come equipped with a temporary spare tire[4]. Thus, the average cost for a new vehicle whose tires didn't meet the standard would be $1.04 (4 * $0.25 * 0.85 + 5 * $0.25 * 0.15) to $4.15 (4 * $1.00 * 0.85 + 5 * $1.00 * 0.15).

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[4] The agency is not requiring temporary spare tires to meet the proposal. The agency has not tested any temporary spare tires, however, the agency suspects that temporary spare tires could not meet the final rule. So, the agency will address temporary spare tires in a separate rulemaking.

On an average vehicle basis, considering those tires that currently fail the test, the average cost would range from $0.05 per vehicle ($1.04*.05) to $0.46 per vehicle ($4.15 * .11).

Total Annual Costs for Tire Upgrade Tests

It is assumed that if the cost of failing tires increases by $0.25 to $1 per tire, then a similar failing aftermarket tire will also increase by the same amount. There are approximately 300 million light vehicle tires sold per year. Approximately 13 million of those are temporary spare tires that are not included in this proposal (assuming 15.5 million light vehicle sales per year * 0.85 with temporary spare tires). Thus, there are an estimated 287 million light vehicle tires sold of which 5 to 11 percent might increase in price by $0.25 to $1 per tire. The total annual cost for meeting the final rule tire upgrade tests is thus estimated to be $3.6 million (287 million tires * .05 * $0.25) to $31.6 million (287 million tires * .11 * $1).

Based on our analysis of the failing rates of tires, the RMA projected costs of $216 million under the RMA proposal are not reasonable for the final rule. With a failing rate of 5 to 11 percent and 287 million tires, the number of failing tires would be 14.35 to 26.1 million tires. $216 million divided by 14.35 to 26.1 million results in an estimated cost of $8.28 to $15.05 per tire. These costs are far out of line with the narrow failing margin, for those tires failing the tests.

RMA also estimated first year costs of about $500 million for additional equipment, development expenses, costs to revise mold drawings and to modify the molds. NHTSA believes that by providing enough lead time that these costs can be subsumed into the normal costs of changing molds that goes on every year. Since most molds are changed every three to four years, the costs of changing them is all part of doing business, and only in those cases where molds would not be normally changed is there an incremental cost. The RMA had many other additional costs in their tables, but many of these new tests are not part of the final rule and those costs are not relevant to this final rule.

Vehicle Costs

GM and other manufacturers commented that the proposed reserve load requirements (based on 85% load at placard pressure) might require a redesign of vehicle architectures to accommodate larger tires and that these costs would be in the hundreds of millions of dollars. The agency considered these comments and reserve load requirement in the final rule is based on 89% load at placard pressure, which will not require tire upsizing on the vast majority of vehicles and will not require any corresponding vehicle redesign. These vehicles also already had optional (larger) tire sizes available for purchase. Thus, the development work for the impact on brakes, traction control, suspension, etc. for these larger tires has already been finished. In the long run, manufacturers may choose to redesigned vehicles to accommodate some larger tire sizes. With the lead time provided by the agency, the agency expects there are no vehicles in the short run which would require any design changes to meet the tire reserve load changes in this final rule.

Testing Costs

There were six tests proposed in the NPRM with which every tire would be required to comply. This section compares the time it takes to run these tests to the time required for the current tests.

1) The high-speed test currently runs for 90 minutes, the final rule test would run for 90 minutes. Thus, there is no change anticipated in testing costs.
2) The endurance test is currently run for 34 hours for P-metric tires and 47 hours for LT tires. The weighted average time is 35.6 hours (34*0.95 + 47*0.05). The endurance test will run for 34 hours for the final rule. (see cost discussion below)
3) The low-inflation endurance test is a new requirement that is run after the endurance test for a 90 minute period. (see cost discussion below)

The final rule tests will require no different testing equipment than is used today. Thus, we do not believe that manufacturers will have to purchase additional test equipment, unless they do increase their testing to insure compliance with the stricter standard.

Labor costs are estimated to be $75 per hour for a manager, $53 per hour for a test engineer and $31 per hour for technicians. We do not anticipate that the test manager will be required to spend any more time on the final rule set of tests than on the current set of tests. We anticipate that only the technician's time will be saved by running the LT tire endurance test for less time. It is anticipated that the test engineer and technician will be involved in running the low-inflation endurance test for 90 minutes. Thus, incremental test costs are estimated to be $76.40 per tire tested (-1.6 hours * $31 = $49.60 for the endurance test and 1.5 hours * [$53 + $31] = $126 for the low pressure test = $76.40). For the early warning rulemaking, the Rubber Manufacturers Association provided NHTSA with an estimate of the number of individual tires made in a year based on SKU numbers, which give individual numbers based on the brand names, tread, ply, fabric, speed rating, and tire size. There are 16,924 P-metric tire brands and 5,235 LT tire brands. Thus, there are 22,159 individual tire brands made a year. Some of these tires are the same, but the brand names are changed and most tires would remain the same for 3-4 years before they are changed. Thus, at the most, 25 percent of the tire brands would be tested on a yearly basis, or 5,540 tire brands. Thus, the incremental testing cost is $423,256 ($76.40 * 5,540 tire brands). This cost is about $0.0015 per tire when divided by the 287 million tires sold per year.

Proposed Lead Time

Section 10 of the TREAD Act requires the agency to issue a final rule on this tire upgrade proposal by June 1, 2002. Congress did not set a lead time by which all tires would be required to meet the new standard. The agency anticipated that some P-metric tires and LT tires would either be taken off the market or redesigned to pass the final rule.

In the NPRM, the agency is proposed two alternative phase-in implementation schedules, and both gave LT tires an additional year to comply with the proposed standard.

In Alternative 1(Proposed Two Year Phase-in Schedule):

All P-metric tires must comply with the final rule by September 1, 2003.

All LT tires must comply with the final rule by September 1, 2004.

In Alternative 2 (Proposed Three Year Phase-in Schedule):

50 percent of P-metric tires must comply with the final rule by September 1, 2003.

All P-metric tires must comply with the final rule by September 1, 2004.

All LT tires must comply with the final rule by September 1, 2005.

Based on the data presented in Table III-3 for all crashes by light truck type, we estimate that 10 percent of light trucks have LT tires. Since future sales are estimated to be split evenly between passenger cars and light trucks, 5 percent of all light vehicles (10% * 0.5) would be equipped with LT tires and 95 percent of all light vehicles would be equipped with P-metric tires.

NPRM Lead Time Comments

RMA supported an effective date for full compliance 5 years after the final rule. Alliance supports a September 1, 2007 effective date, with optional compliance to FMVSS 109 or 139 during that phase-in period. The Alliance also wants the agency to undertake further analysis of existing data and collect additional data as is needed to provide a sound scientific basis for the revised tire regulatory requirements that meet demonstrated safety needs. This would include research to: 1) establish the extent of tire failure; 2) determine the role of tire failure in crash causation; 3) determine the role of various factors such as loading, speed, and low inflation pressure in observed tire failures; 4) establish the correlation of aging, bead unseating, and road hazard impact tests to real world performance. Consumers Union wants the new rule to be implemented as soon as possible. Advocates supported neither implementation schedule. They believe that LT tires need to be improved just as quickly as, if not more quickly than, P-metric tires and urged an effective date of September 1, 2002 for all tires to comply with the new requirements.

Agency Lead Time Decision

The agency has decided to require an effective date of 4 years after the final rule is published, for both P-metric tires and LT tires. The agency believes that this provides sufficient lead time for tire manufacturers and vehicle manufacturers to make any necessary design changes for their tires to comply with the new requirements, and also quickly provide the American public with tires that are certified to a more stringent standard. The vehicle manufacturers need lead time to make the necessary changes to current vehicles to accommodate new tires and tire pressure monitoring system requirements. In addition, the 4-year effective date would coincide with the effective date requirements for TPMS, which becomes mandatory for all light vehicles in 2006.

VI. SMALL BUSINESS IMPACTS

A. Regulatory Flexibility Act

The Regulatory Flexibility Act of 1980 (5 U.S.C. §601 et seq.) requires agencies to evaluate the potential effects of their proposed and final rules on small businesses, small organizations and small governmental jurisdictions. The agency believes that most tire manufacturers are not small businesses. The final rule only affects radial tires, thus specialty tire manufacturers that may be considered small businesses can continue to produce non-radial tires. However, the relatively few specialty tire manufacturers who produce radial tires for passenger vehicles must comply with FMVSS No. 139.

These small business tire manufacturers will have to pass the more stringent high speed and endurance test requirements and the new low-pressure endurance test. The new low-pressure test adds very little cost since it is conducted at the end of the endurance test on the same fixture. The additional test cost is estimated to be $76.40 per tire line. We do not know whether or how many radial tires produced by small businesses might fail the final rule requirements. But we believe this cost impact is not economically significant, even if they do fail.

There are thousands of small tire retail outlets that will in some small way be impacted by this rule. However, we anticipate that the increase in price per tire as a result of the final rule will have no real impact on small businesses, as they will just pass these price increases on to consumers.

B. Unfunded Mandates Reform Act

The Unfunded Mandates Reform Act of 1995 (Public Law 104-4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditures by State, local or tribal governments, in the aggregate, or by the private sector, of more than $100 million annually (adjusted annually for inflation with base year of 1995). Adjusting this amount by the implicit gross domestic product price deflator for the year 2000 results in $109 million (106.99/98.11 = 1.09). The assessment may be included in conjunction with other assessments, as it is here.

This final rule is not estimated to result in expenditures by State, local or tribal governments of more than $109 million annually. Nor is it likely to result in the expenditure by automobile manufacturers and/or their tire suppliers of more than $109 million annually. The estimated annual cost is $3.6 to $31.6 million.

VII. COST EFFECTIVENESS

This section combines costs and benefits to provide a comparison of the estimated injuries and lives saved per net cost. Benefits were estimated for the tire performance upgrade part of the rule but could not be estimated for the increase in tire reserve load. Thus, a cost effectiveness estimate is only calculated for the tire performance upgrade part of the final rule. Tire costs occur when the tire is purchased, but benefits accrue over the lifetime of the tire. Benefits must therefore be discounted to express their present value and put them on a common basis with costs.

In some instances, costs may exceed economic benefits, and in these cases, it is necessary to derive a net cost per equivalent fatality prevented. An equivalent fatality is defined as the sum of fatalities and nonfatal injuries prevented converted into fatality equivalents. This conversion is accomplished using the relative values of fatalities and injuries measured using a "willingness to pay" approach. This approach measures individuals' willingness to pay to avoid the risk of death or injury based on societal behavioral measures, such as pay differentials for more risky jobs.

Table VII-1 presents the relative estimated rational investment level to prevent one injury, by maximum injury severity. Thus, one MAIS 1 injury is equivalent to 0.0045 fatalities. The data represent average costs for crash victims of all ages. The Abbreviated Injury Scale (AIS) is an anatomically based system that classifies individual injuries by body region on a six point ordinal scale of risk to life. The AIS does not assess the combined effects of multiple injuries. The maximum AIS (MAIS) is the highest single AIS code for an occupant with multiple injuries.

Table VII-1

Comprehensive Fatality and Injury Relative Values	
Injury Severity	2000 Relative Value* per injury
MAIS 1	.0045
MAIS 2	.0469
MAIS 3	.0933
MAIS 4	.2173
MAIS 5	.7138
Fatals	1.000
* includes the economic cost components and valuation for reduced quality of life	

Source: "The Economic Impact of Motor Vehicle Crashes, 2000", NHTSA, 2002.

In Chapter IV the benefits of 1-4 lives saved, 23-102 injuries reduced, and $373,000 to $1.64 million in property damage and traffic delays were estimated. The injuries can be divided into the following AIS levels, based on the distribution of AIS levels in the target population as follows:

Table VII-2
Distribution of Injury Benefits

AIS 1	AIS 2	AIS 3	AIS 4	AIS 5	Total
18 – 81	3 - 15	1 – 3	1 - 2	0 - 1	23 – 102

Table VII-3 shows the estimated equivalent fatalities. The injuries benefits are weighted by the corresponding values in Table VII-1, added to the fatalities, and then summed.

Table VII-2
Equivalent Fatalities

Fatality Benefits	Injury Benefits	Equivalent Fatalities
1 - 4	0.5 – 2.2	1.5 - 6.2

Costs

The annual tire performance upgrade costs are estimated to be $3.6 to $31.6 million.

Net Cost/Equivalent Fatality Before Discounting

There are different ways of combining costs and benefits. We could compare the high end of the costs to the low end of the benefits and the low end of the costs to the high end of benefits. Thus, we would have:

($3.59 million in costs - $1.64 million in property damage)/6.2 equivalent fatalities = $0.31 million per equivalent life saved, to

($31.57 million – $0.37 million in property damage)/1.5 equivalent fatalities = $20.8 million per equivalent life saved.

This results in a very wide range.

A more useful approach is to compare the mid-point of the range of costs to the mid-points of the ranges of benefits and get a most likely cost per equivalent life saved. The mid-point of the range of costs is $17.58 million ([$3.59 + $31.57]/2). The mid-points in the ranges of benefits are $1.005 million ([$1.64 + $0.37]/2) in property damage and 3.85 ([6.2 + 1.5]/2) in equivalent fatalities. Thus, the most likely cost per equivalent life saved is $4.31 million ([$17.58 million - $1.005 million]/3.85) undiscounted.

Appendix V of the "Regulatory Program of the United States Government", April 1, 1990 - March 31, 1991, sets out guidance for regulatory impact analyses. One of the guidelines deals with discounting the monetary values of benefits and costs occurring in different years to their present value so that they are comparable. Historically, the agency has discounted future benefits and costs when they were monetary in nature. For example, the agency has discounted future increases in fuel consumption due to the increased weight caused by safety countermeasures, or decreases in property damage crash costs when a crash avoidance standard reduced the incidence of crashes, such as with center high-mounted stop lamps. The agency has not assigned dollar values to the reduction in fatalities and injuries, thus those benefits have not been discounted. The agency performs a cost-effectiveness analysis resulting in an estimate of the cost per equivalent life saved, as shown on the previous pages. The guidelines state, "An attempt should be made to quantify all potential real incremental benefits to society in monetary terms of the maximum extent possible." For the purposes of the cost-effectiveness analysis, the Office of Management and Budget (OMB) has requested that the agency compound costs or discount the benefits to account for the different points in time that they occur.

There is general agreement within the economic community that the appropriate basis for determining discount rates is the marginal opportunity costs of lost or displaced funds. When these funds involve capital investment, the marginal, real rate of return on capital must be considered. However, when these funds represent lost consumption, the appropriate measure is the rate at which society is willing to trade-off future for current consumption. This is referred to as the "social rate of time preference," and it is generally assumed that the consumption rate of interest, i.e. the real, after-tax rate of return on widely available savings instruments or investment opportunities, is the appropriate measure of its value.

Estimates of the social rate of time preference have been made by a number of authors. Robert Lind[1] estimated that the social rate of time preference is between zero and 6 percent, reflecting the rates of return on Treasury bills and stock market portfolios. Kolb and Sheraga[2] put the rate at between one and five percent, based on returns to stocks and three-month Treasury bills. Moore and Viscusi[3] calculated a two percent real time rate of time preference for health, which they characterize as being consistent with financial market rates for the period covered by their study. Moore and Viscusi's estimate was derived by estimating the implicit discount rate for deferred health benefits exhibited by workers in their choice of job risk.

While different discount values could be considered, 7 percent is the current OMB requirement, which represents the marginal pretax rate of return on an average investment in the private sector in recent years.

Safety benefits can occur at any time during the tire's lifetime. For this analysis, the agency assumes that the tires are purchased in the beginning of year 5 for a typical passenger car or light truck and used for an average 45,000 miles. Table VII-3 shows the estimated distribution of

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[1]Lind, R.C., "A Primer on the Major Issues Relating to the Discount Rate for Evaluating National Energy Options," in Discounting for Time and Risks in Energy Policy, 1982, (Washington, D.C., Resources for the Future, Inc.).

[2]J. Kolb and J.D. Sheraga, "A Suggested Approach for Discounting the Benefits and Costs of Environmental Regulations,: unpublished working papers.

[3]Moore, M.J. and Viscusi, W.K., "Discounting Environmental Health Risks: New Evidence and Policy Implications," Journal of Environmental Economics and Management, V. 18, No. 2, March 1990, part 2 of 2.

miles traveled for a typical new tire purchased, and the weighted discount factor for benefits of 0.873.

Table VII-3

Year	Miles Traveled	Discount Factor	Total Discount Factor
1	11,392	.9667	11,013
2	10,979	.9035	9,920
3	10,581	.8444	8,935
4	10,198	.7891	8,047
5	1,850	.7375	1,364
Total	45,000		39,279/45,000 = 0.873

This value (0.873) is multiplied by the property damage savings and by the equivalent lives saved to determine their present value (e.g., in Table VII-2 (1.5 x .873 = 1.3). The net costs per equivalent life saved for passenger cars and light trucks are then recomputed and are shown below.

Again, if you compare the high end of the costs to the low end of the benefits and the low end of the costs to the high end of benefits, you have a very wide ranges for the

Net Cost/Equivalent Fatality After Discounting by 7 Percent

($3.59 million in costs - $1.43 million in property damage)/5.4 equivalent fatalities = $0.40 million per equivalent life saved, to

($31.57 million – $0.32 million in property damage)/1.3 equivalent fatalities = $24.0 million per equivalent life saved

A more useful approach is to compare the mid-point of the range of costs to the mid-points of the ranges of benefits and get a most likely cost per equivalent life saved. The mid-point of the range of costs is $17.58 million ([$3.59 + $31.57]/2). The mid-points in the ranges of benefits are $0.875 million ([$1.43 + $0.32]/2) in property damage and 3.35 ([5.4 + 1.3]/2) in equivalent fatalities. Thus, the most likely cost per equivalent life saved is about $5 million ([$17.58 million - $0.875 million]/3.35) after discounting.